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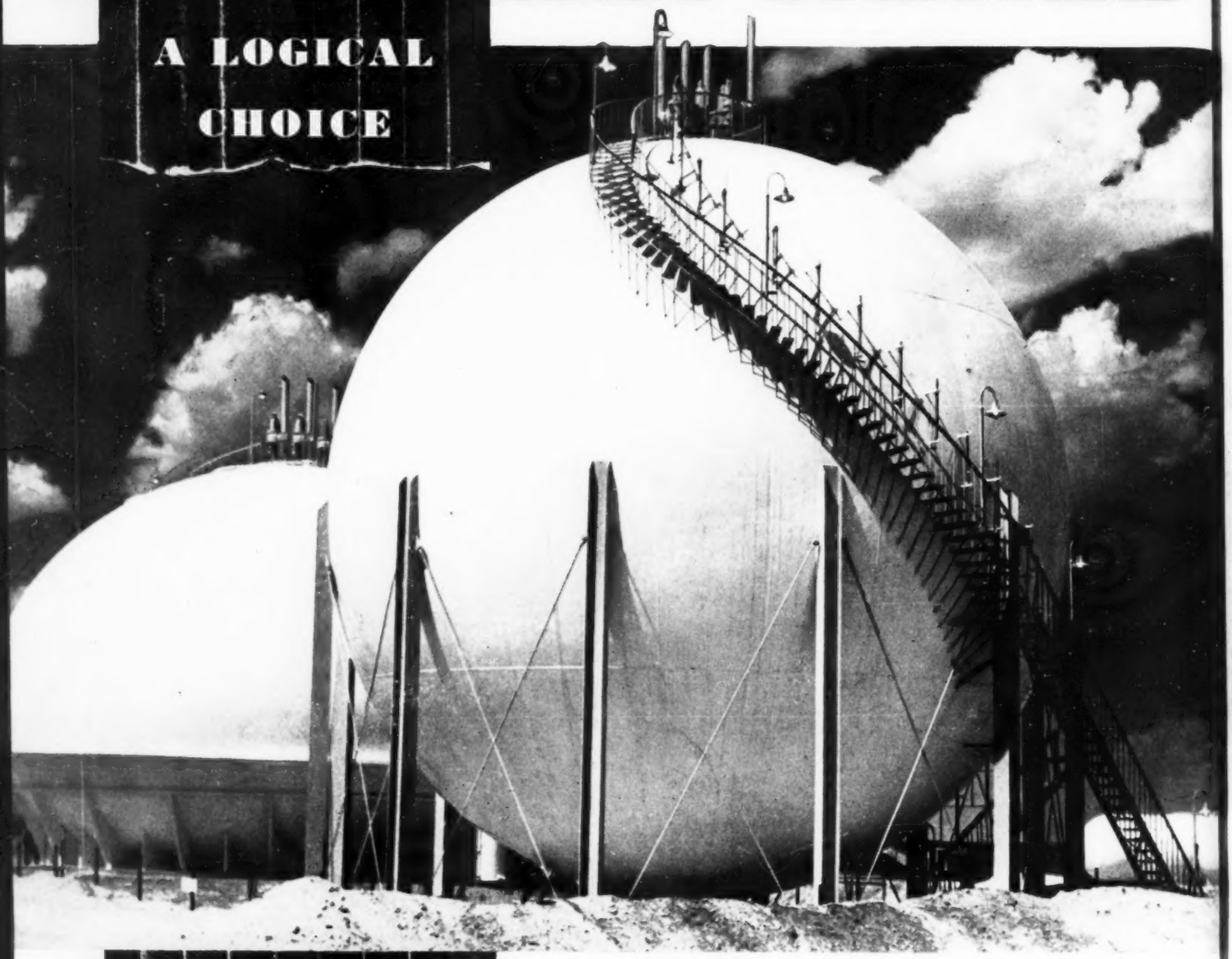

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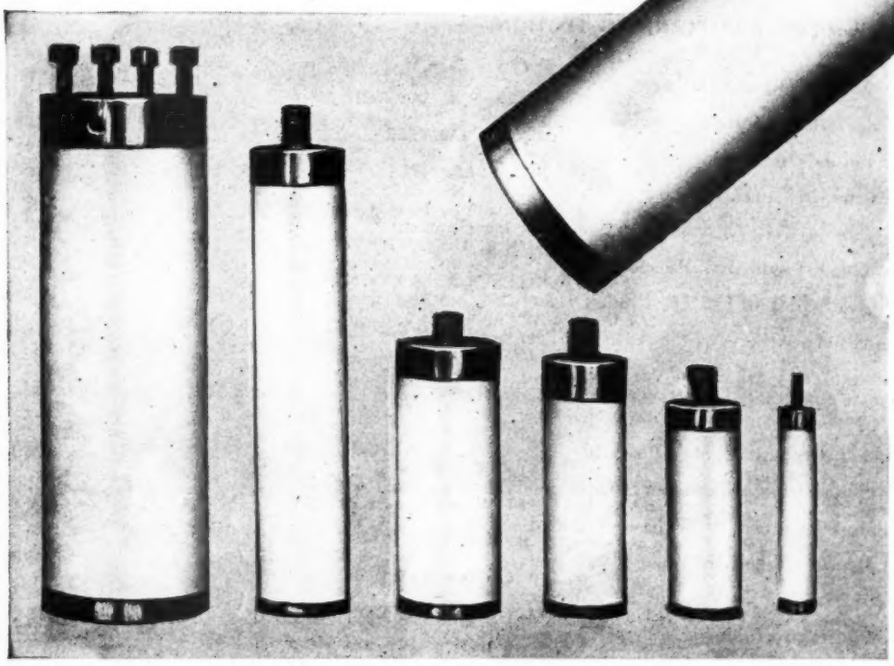

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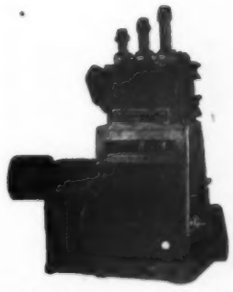

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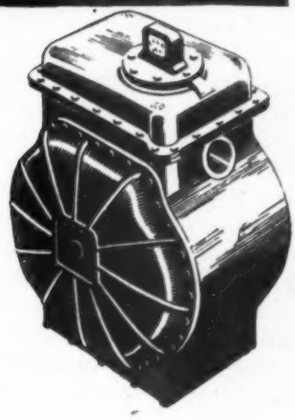

The Course of Oil

by K. C. SCLATER

INTERNATIONAL OIL TRENDS

International trends in petroleum are engaging the attention of the oil industry as never before, and well they might, for petroleum's role in war and its value as a world commodity in time of peace have focused attention on the world's oil resources and how their development will be affected in the postwar period.

Interest in foreign oil is also increasing because of the rapid decline of available domestic oil reserves. Assuming that the present trend continues, it is estimated that the United States will be short of filling all military and civilian needs by 154,000 barrels, 266,000 barrels, 323,000 barrels, and 512,000 barrels daily for the first, second, third, and fourth quarters, respectively, of 1944. The deficiency will have to be made up from oil supplies outside the United States.

Evidence justifying the increasing attention of the oil industry in foreign oil is also contained in a report of the PIWC's Committee on Petroleum Economics wherein it is stated that an effective basis of cooperation between the Armed Forces and the PAW in working out a satisfactory world oil program has been reached. Although the details are not available for publication, the pertinent factors in the world supply situation are being given increasing consideration. This is reflected in the fact that a larger proportion of petroleum war demands are being taken from other than U. S. sources during recent weeks.

What part the Petroleum Reserves Corporation will play in the world oil picture has not been divulged. Its charter and powers are broad, hence any commitments it may make are likely to affect directly the operations of U. S. oil companies in foreign fields, and indirectly oil operations in this country.

PAW's Directive 70 of October 12, sets up a world-wide oil pool that fits into PRC's plan, whatever that may be. Under this new directive the Foreign Operations Committee of the PAW is given greater responsibilities in coordinating the foreign operations of American oil companies during the war emergency. This committee is empowered to utilize, without regard to ownership or control, available tanker and cargo vessels, barges, terminal storage, refining, blending, dispensing, and other facilities to transport and handle petroleum from the supply points nearest to the areas or countries to be supplied, so as to avoid multiple port loading and unloading, cross hauling, unnecessary ballast voyages, and so as to achieve maximum efficient wartime utilization of all other facilities to reduce to a minimum idle time in port and splitting of cargoes between two or more ports of discharge.

Subject to the approval of the PAW the Committee will also determine requirements of each foreign country or area to be supplied, and within limits of foreign supply, shall prepare and submit to PAW, detailed supply and import allocation schedules for each area or country. When such action is required, upon request by PAW, the Committee shall also prepare detailed supply and import allocation schedules for import of petroleum into the United States, and shall submit such schedules to PAW for approval. The Committee shall also cooperate with and coordinate its activities with the British Overseas Supply Committee and Ministry of War Transport, and with such other appropriate committees or agencies as may be established or approved by the Government of the United States or by any of its allies or by friendly nations.

International trends in petroleum are therefore of prime importance and merit the attention being accorded them within the industry. It would seem that the oil industry of the United States must extend its interest in oil to include all foreign producing or prospective oil fields. Likewise, oil producers will find it necessary to extend their viewpoint of oil development to areas beyond the confines of this country.

SALT WATER REINJECTION

Reinjection of salt water in the East Texas field has demonstrated its effectiveness in retarding the decline of reservoir pressure. During the first eight months of this year, a total of 40,685,000 barrels of salt water was returned to the sand. During that same period a total of 83,736,000 barrels of oil was produced. The result is that average drop in reservoir pressure during 1943 is now less than five hundredths of a pound per million barrels of oil produced. This is only one-ninth of the average pressure drop per million barrels since the discovery of the field. In other words, the return of salt water to the reservoir has resulted in increasing the quantity of oil produced per pound of reservoir pressure drop from about two and one-quarter million barrels to twenty and one-half million barrels. This will lead ultimately to substantial savings in pumping costs during the remaining life of the field.

GAS WASTE OVERLOOKED?

A political controversy has arisen in regard to transporting gas out of Texas to industrial areas in other states. In this connection, E. O. Thompson of the Texas Railroad Commission made a very pointed statement last month to the Interstate Oil Compact Commission, suggesting that natural gas produced with oil that is not reinjected for pressure maintenance should be required to be utilized through the nearest gas transmission line. This gas, in his opinion, should come first in filling the demand for gas and the rest supplied by higher pressure gas fields.

It would be interesting—and probably surprising—to learn what is the total volume of natural gas being dissipated daily from producing oil wells in the state.

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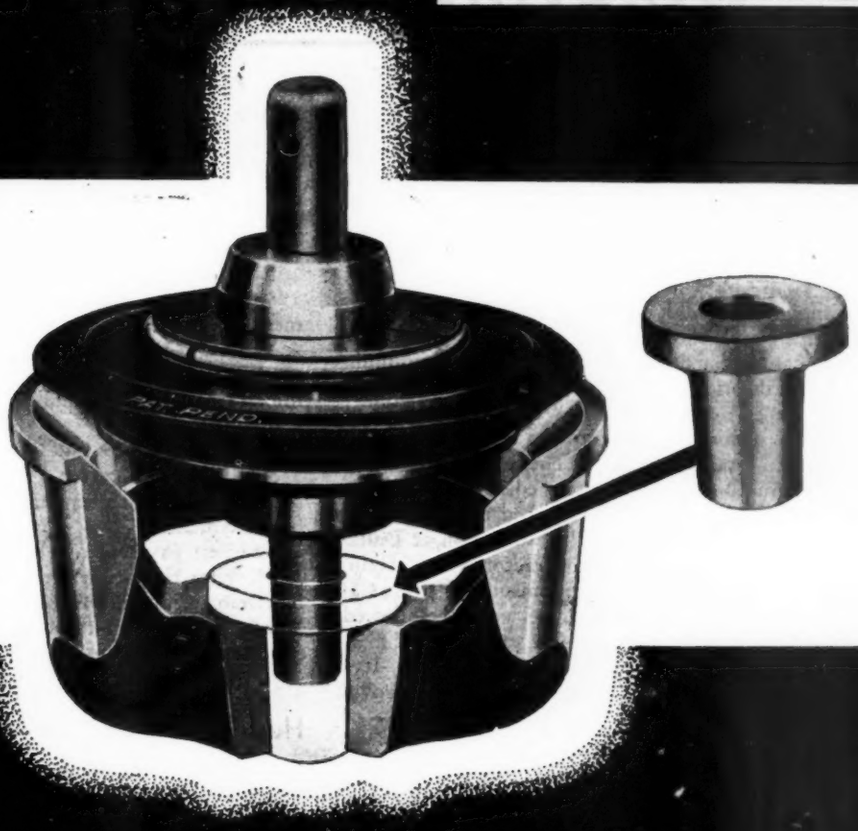

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Highlights IN OILDOM

Single Wage Bracket for Drillers

The National War Labor Board has acted favorably on the application of the American Association of Oilwell Drilling Contractors to establish a horizontal minimum wage for the entire Mid-Continent area, the Rocky Mountain states, and certain other oil producing states lying east of the Mississippi River.

In establishing horizontal minimum and maximum wage rates for the entire area, the Board has made it possible for any rotary drilling contractor to pay up to the specified minimums for any job classification, provided application is made on Form 10 and properly filed with the War Labor Board's regional office. Any drilling contractor who is now paying less than the minimum established for the entire area may obtain permission on Form 10 to pay any intermediate rate he desires between his present rate and the established minimum, it is stated from the executive offices of the association at Dallas, Texas. This means that if a drilling contractor is now paying a driller $1.44 per hour, he may ask permission to pay $1.50 per hour instead of the $1.58 per hour he would be allowed. Minimum rates are the highest that can be paid, and the maximum rates have no special significance at this time, it is pointed out. Higher wages are not to be paid before approval, however.

Efficient Use of Drilling Manpower

Specific suggestions for maximum efficient use of available manpower in oil well drilling operations were outlined recently by Harold L. Ickes, Petroleum Administrator for War.

Taking cognizance of a growing manpower shortage that has delayed drilling of individual wells as long as 90 days, Ickes said that the results of a partially completed nationwide survey indicate that unless former oil workers can be induced to return to the industry, the wildcat and oil field development programs will fall far behind schedule.

"In the meantime," Ickes emphasized, "it is urgently necessary that the industry utilize to the fullest extent every man presently available to it. With this in mind, we believe it is consistent to urge that producers and operators who employ the services of drilling contractors give serious consideration to the following five points:

"1. That the drilling of wells by producing companies be scheduled in advance to produce a continuity of operations for the contractors' crews and equipment, insofar as is practicable;

"2. That the contractor be given notice at least 30 days prior to the time of permanently releasing his men and equipment so he may seek work elsewhere for this equipment and these crews;

"3. That companies contemplating the use of contractors' services give the contractor as much as 30 days' notice, whenever practicable, before requiring him to move onto a new location;

"4. Where an unavoidable delay may be occasioned and the time for such delay can be computed, that the contractor be notified of the length of such delay so that his men will be laid off for only a definite period of time, instead of indefinitely, and

"5. In proved territory when use of more than one rig is contemplated by a producer, permit the contractor to have at least two rigs in operation so that a savings may be effected in supervision, trucking equipment, and equipment used in setting various sizes of casing."

Agree on Terms of Mexican Oil Settlement

The State Department at Washington has made public terms agreed upon for final settlement by Mexico for oil properties expropriated from American nationals in 1938. The Mexican government is to pay $20,137,700.84, which is in addition to $9,000,000 cash paid in 1941.

Payments began September 30 with a remittance of $3,796,391.04, and the remainder is to be paid in four annual installments.

The State Department announced the agreement had been reached through an exchange of notes by Adolf Berle, Jr., acting secretary of state, and Rafel de la Colina, Mexican charge d'affaires.

The total of $29,137,700.84 represents $23,995,991 plus $5,141,709.84 interest at 3 percent on all unpaid balances from March 18, 1938, to September 30, 1947, the date set for the final payment.

The first payment of $9,000,000 was made November 19, 1941, when the two governments agreed to appoint experts to determine just compensation for the oil properties. The experts, Morris L. Cooke for the United States, and Manuel J. Zevada for Mexico, determined the evaluation in a report on April 17, 1942.

Hearing on Unit Operation

Secretary of the Interior Harold L. Ickes has announced a three-day public hearing in Denver, Colorado, beginning November 17, on suggested regulations governing the development and operation as a unit of oil and gas deposits on public lands. The hearing will be open to oil and gas lessees, operators, members of the petroleum industry generally, and others who may be interested in or affected by the regulations.

Committee to Study Unit Plan

A special committee of operating oil men has been appointed by Warner Clark, chairman of the Conservation Committee of California Oil Producers, to study the recently proposed "Regulations for Oil and Gas Unit Plan," which is being sponsored by the U. S. Geological Survey.

The committee's work will be to analyze the proposed regulations and consider them in light of operations in California. The committee will formulate and present modifications of the plan in order to solve local oil field problems.

In several California oil fields of the San Joaquin Valley District, producing companies are considering utilization plans of operation. Therefore, this subject is of immediate interest. The committee is composed of seven members. A national hearing will be held in Denver beginning November 17.

The members of the committee are: Robert M. Allan, Jr., chairman, The Superior Oil Company; L. A. Cranson, Honolulu Oil Corporation; Olen Lane, Continental Oil Company; Ross McCollum, National Oil Company; B. E. Parsons, General Petroleum Corporation; R. C. Patterson, Belridge Oil Company, and C. P. Watson, Seaboard Oil Company of Delaware.

Plan Exploration in Mexico

Plans for oil exploration were discussed early this month at a meeting in Mexico City of 23 Mexican geologists, Efrain Buenrostro, general manager of Petroleos Mexicanos, announced. Several geologists from the United States also were present in an advisory capacity.

Importation of seismograph and drilling equipment from the United States will be sought, Buenrostro said.

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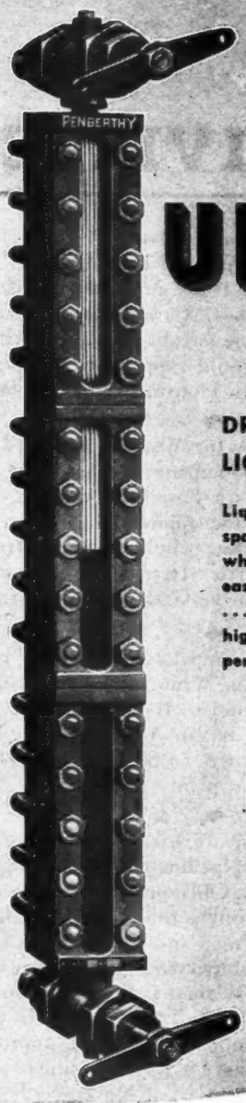

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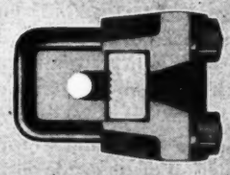

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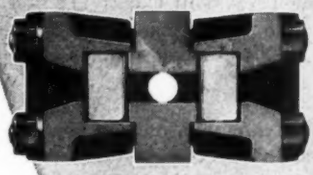

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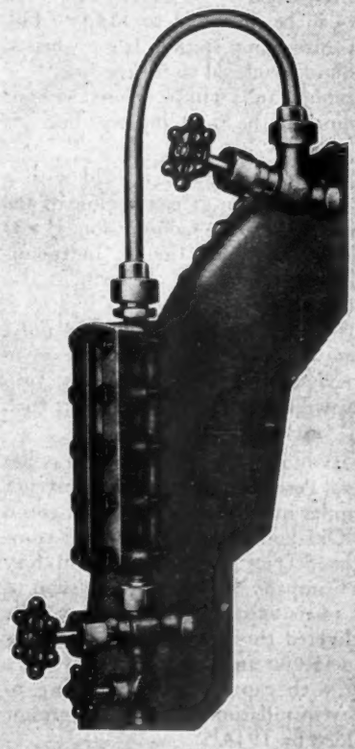

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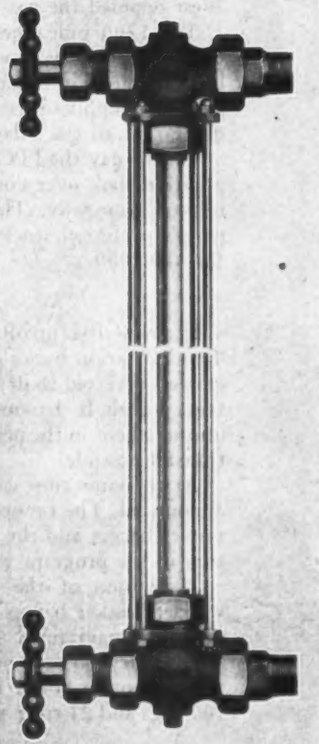

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MAJOR *Pipe Line* ACTIVITIES

THE Magnolia Pipe Line Company has let contracts for construction of its 337-mile, 12-in. crude oil line from Midland to Corsicana, Texas, to the Oklahoma Contracting Company and Jones and Brooks, both of Dallas, Texas. The first three sections of the line from Midland eastward to the Bosque River, which is the greater part of the line or 256 miles in length, went to the Oklahoma Contracting Company. Work is scheduled to begin on these sections about October 25.

Jones and Brooks have a contract for the rest of the line, the 81 miles from the Bosque River to Corsicana. Work will begin as soon after November 1 as delivery of pipe can be made.

The new pipe line will provide a much needed additional outlet for the oil of the rich West Texas-New Mexico Permian Basin, an area in which United States crude oil production can be substantially increased, it is thought by the Petroleum Administration for War.

The pipe line will carry 42,000 bbl. of crude oil daily from the Seminole and adjacent fields to connecting pipe lines that serve refineries on the Texas Gulf Coast. The first part of the line is to be built with second hand pipe. The $6,000,000 project was alloted 29,900 tons of steel.

The Tennessee Gas and Transmission Company, Chattanooga, Tennessee, was issued a certificate by the Federal Power Commission for the construction, operation, and maintenance of a new natural gas pipe line from Driscoll, Texas, near Corpus Christi, to the Cornwall compressor station of the Hope Natural Gas Company near Charleston, West Virginia, to augment failing natural gas supplies in the Appalachian area.

Ten days later the FPC postponed indefinitely a hearing on the application of the Hope Natural Gas Company for authority to construct a similar line from the Hugoton gas field of Oklahoma and Kansas.

Strong opposition to both pipe lines was revealed in the hearings. Coal interests and labor from the East protested the project. State officials, newspapers and some oil men from the West opposed the gas line.

The 1200 mile line requires about 215,000 tons of steel. Opposition to the line said that the essential materials could be better used in other work and that the East had plenty of coal. The supply of gas at the rate of 200,000,000 to 300,000,000 cu. ft. of gas a day might be short lived, objectors stated.

On the day the FPC granted permission, The Chicago Corporation took over control of the Tennessee Gas and Transmission Company. The Chicago firm acquired all the company's preferred stock and 90 percent of its common stock for $500,000.

In a new shakeup of its barge program, the Office of Defense Transportation has ordered 55 craft originally scheduled as oil carriers diverted to dry cargo use on the Mississippi River system. Joseph B. Eastman, ODT director, said the continued improvement in the petroleum transportation system made the transfer possible.

At the same time cancellation for 13 steel tank barges was announced. The revised steel barge program will include 100 tanker barges and the 55 converted to dry cargo. The reduction in the program will save 2400 tons of steel.

A revision of the wooden barge program calls for 159 wooden tanker barges with 110 others now under construction to be maintained as a floating reserve for quick conversion to oil or dry cargo as needed.

The motive power construction program, which calls for 100 tugs and 21 river tow boats, will be completed as planned.

Proposed by Representative L. Mendal Rivers (Democrat) of South Carolina is the Victory Oil Line to gather oil in the Houston-Beaumont area of Texas and move it to the great naval bases at Charleston, South Carolina, and Norfolk, Virginia. A member of the House naval affairs committee, Rivers said that the proposed line could supply oil to 107 naval and military installations between Houston and Norfolk.

Petroleum Administration for War has endorsed the proposal of Stanolind Pipe Line Company to construct a 225-mile, 10-in. line from Elk Basin to Casper, Wyoming. The War Production Board received the application for the line and had PAW pass on it. The line would move oil from many areas to tie into Stanolind's artery from Salt Creek to Freeman, Missiouri, and from there to the Great Lakes territory.

The West Texas Utilities Company is laying a 21-mile, 6-in. welded steel pipe line from the White and Baker field in Pecos County to the plant near Girvin. It will purchase gas from the Cardinal Oil Company of San Angelo, Texas. Interconnected lines will transmit power to South Texas, Oklahoma, and Arkansas from the Girvin plant.

Stanolind Pipe Line Company has awarded contracts for construction of its crude oil pipe line from the Slaughter pool of West Texas to Drumright, Oklahoma. For the first section, starting at Slaughter, the contractor is I. C. Little, Dallas, Texas; for section two, Sharman and Allen, Houston, Texas; for sections three and four, Midwestern Engineering and Construction Company, Tulsa, Oklahoma; for section four, O. C. Whitaker Company, Fort Worth, Texas.

Each section of the 385-mile, 16-in. line is approximately 75 miles long. Delivery of pipe for the main line has been delayed and it will probably be the last of November before construction crews begin work. The line is scheduled for completion about April 1.

The line will have an initial capacity of 65,000 bbl. with two pump stations, which can be increased to 116,000 bbl. daily with the addition of a third pump station. It is estimated that it will take 400,000 bbl. of crude oil to fill the line.

Eight 80,000 bbl. steel storage tanks will be erected at Sundown, in West, Texas, terminal of the Stanolind pipe line.

Application to tap the Hugoton natural gas field with a 300-mile southern Kansas pipe line right after the close of the war is on file with the Kansas Corporation Commission. It was submitted by the Grand Trunk Pipe Line, Inc., of Independence, Kansas. Paul R. Johnson, president of the firm, is also president of the Union Gas System, Inc.

The line would extend from the Hugoton field 300 miles east to near Chanute, Kansas, with a compressor station in Grant County. It is proposed to serve all other intersecting gas carriers and municipal distribution systems that want fuel.

Cities Service Transportation and Chemical Company has been authorized by the Federal Power Commission to construct a 26-in. gas pipe line 231 miles in length from the Hugoton gas field in Texas County, Oklahoma, to the Blackwell compressor station of the Cities Service Gas Company in Kay County. Cities Service Gas Company was given permission to construct certain additions to its existing facilities to handle the additional gas to be delivered through the new line. The gas pipe line will cost $10,635,000 and is estimated to carry 140,000,000 cu. ft. a day with capacity for increasing to 240,000,000 cu. ft. a day by installation of more compressor facilities. These are to be added by 1946.

MAJOR *Refining* ACTIVITIES

THE world's largest synthetic rubber plant with capacity for producing 120,000 tons of man-made rubber annually has been completed at Port Neches, Texas, by The B. F. Goodrich Company, and is now producing rubber. The giant plant, capable of turning out a fifth of the nation's normal rubber requirments, is the largest to be constructed in the government's synthetic rubber program. B. F. Goodrich will operate two of the 30,000 ton units.

Beginning of manufacturing operations in the new plant, known in Texas as "Rubber Rancho Grande," were observed in Beaumont and Port Arthur with civic meetings where George W. Vaught, Goodrich vice president, was the principal speaker. Butadiene for the "Rubber Rancho" comes by pipe line direct from the new plant of the Neches Butane Products Company, only a few hundred feet away. Gulf Oil Corporation, The Texas Company, Pure Oil Company, Atlantic Refining Company, and Magnolia Petroleum Company are the constituent companies in this organization.

Other butadiene plants are operated at Baytown by Humble Oil and Refining Company, at Borger by the Phillips Petroleum Company, and at Houston by the Sinclair Refining Company. The styrene for Texas rubber will be produced by plants operated by the Monsanto Chemical Company at Texas City and by the Dow Chemical Corporation at Velasco.

B. F. Goodrich also operates a large synthetic plant in Louisville, Kentucky, and is building another plant there to be operated by a group of small companies on completion. A government plant at Borger, Texas, with a capacity of 45,000 tons, was built by B. F. Goodrich and began producing rubber early in August.

The senate public lands committee has reported favorably a bill for the construction of plants to provide petroleum products from coal and other substances. Senator O'Mahoney, Democrat, Wyoming, is author of the bill.

The Magnolia Petroleum Company has opened the world's first two thermofor catalytic cracking units at its Beaumont, Texas, refinery. The thermofor catalytic cracking process is designed to produce a greater product yield and a higher quality of aviation gasoline from crude oil, according to the company.

It is said that two and a half years of testing and improving this new technique in a plant with a capacity of 500 bbl. a day have shown the process to have outstanding advantages in the production of high octane base stock, as well as stock for alkylate for 100-octane gasoline and for butylene, used in the manufacture of synthetic rubber.

Magnolia technicians said that the thermofor catalytic cracking process permits use of a wider variety of crudes and gives the refiner better control over proportionate quantities of the products made.

Standard Oil Company of Indiana recently completed a new toluene plant at its Whiting, Indiana, refinery and expects to be shipping more toluene for manufacture of TNT for bombs for America's war planes than all sources in the United States produced in World War I. With construction of other new units Standard of Indiana will also rank as one of the leading producers of 100-octane aviation gasoline. Most of these new structures will be completed by the end of the year. Included are new alkylation, isomerization, and catalytic cracking units and new fractionating towers.

The Defense Plant Corporation announces it has authorized a contract with Humble Oil and Refining Company, Houston, Texas, for plant facilities costing approximately $2,750,000.

An increase of $1,660,000 was announced by the Defense Plant Corporation in its contract authorization with the National Refining Company, for additional facilities at the company's plant in Coffeyville, Kansas. This would bring the overall commitment to $4,800,000.

Construction has begun on a $100,000 casinghead gasoline plant in the Hawkins field on the southern border of Wood County, Texas, for the Warren Petroleum Corporation. The plant will have four units and is expected to employ 25 men on each of two 12-hour shifts. The company plans to have the plant in operation by Christmas.

Petroleum Administrator for War Harold L. Ickes has announced that refiners in the Rocky Mountain States (District 4) have been called upon to increase their yields of heating oils and motor gasoline. Telegrams sent to all refiners in the Rocky Mountain region in part read: "In view of the firm position of residual oil in District 4 and the indicated need for additional heating oil and motor gasoline there, it is now advisable to increase the yields of 'light' products. Therefore, effective immediately and until further advised, the limitation on motor gasoline yield as established by Davies' Directive, July 7, 1942, is removed."

The directive issued in July, 1942, by Deputy Petroleum Administrator Ralph K. Davies called upon refiners in the Rocky Mountain area to increase yields of residual fuel oils, stocks of which were then critically low, at the expense of gasoline yields, which were held to 80 percent of the average yield during the last half of 1941. Now that the residual oil stocks have been increased, the refining emphasis will be placed on building up inventories of home-heating fuel oil and motor gasoline to the extent that this does not interfere with manufacture of maximum quantities of 100 and 91 octane aviation gasoline, toluene, butadiene, and other important war products.

Crude Runs to Stills, Production[1] and Stocks[2] of Motor Fuels
Week Ended September 25, 1943
A.P.I. Figures
(Figures in thousands of bbl. 42 gal. each)

DISTRICT	DAILY REFINING CAPACITY		CRUDE RUNS TO STILLS[3]			
*Combined: East Coast, Texas Gulf, North Louisiana-Arkansas, and Inland Texas	Potential Rate 2,444	Percent Reporting 88.7	Daily Average 2,060	Percent Operated 84.3	Total Production 13,380	Total Stocks 75,113
Appalachian						
District No. 1	130	83.9	102	78.5	525	2,910
District No. 2	47	87.2	56	119.1	294	1,053
Ind., Ill., Ky.	824	85.2	717	87.0	4,623	25,406
Okla., Kans., Mo.	416	80.1	350	84.1	2,141	10,819
Rocky Mt.						
District No. 3	8	26.9	8	100.0	66	133
District No. 4	139	57.7	104	74.8	668	2,420
California	817	89.9	759	92.9	5,180	71,809
TOTAL U. S.— SEPT. 25, 1943	4,825	86.4	4,156	86.1	26,811	189,663
TOTAL U. S.— SEPT. 18, 1943	4,825	86.4	4,209	87.2	27,144	190,190
U. S.— SEPT. 26, 1942			3,834		23,575	406,304

*At the request of the Petroleum Administration for War.
[1]Production—total of gasoline at refineries including natural and blended; kerosine, gas oil and distillate fuel oil, and residual fuel oil.
[2]Stocks—at refineries, bulk terminals, in transit, and pipe lines of finished and unfinished gasoline; kerosine, gas oil and distillate fuel, and residual fuel oil.
[3]Figures on production and stock include reported totals plus an estimate of unreported amounts and are therefore on a Bureau of Mines basis.

MAJOR *Oil Field* ACTIVITIES

▶ **Texas.** Southeastern Andrews County has a pool opener in The Texas Company No. 1 J. E. Mabee. An average of 17 bbl. of pipe line oil was swabbed hourly when the hole was bottomed at 4719 ft. It will be tested at 4770 ft. as the result of a log of 125 ft. of San Andres lime. The well is situated in C NE SW of 37-40-2n.

▶ **Arkansas.** Crude oil is flowing into storage tanks from the Arkla Oil Company No. 1 Wheless-Wisinger, NW¼ SW¼ of 9-20-27, south Miller County. Indications are that the well is a good producer and will open a new pool. It showed heavy gas pressure.

▶ **Oklahoma.** Gulf Oil Corporation and Devonian Oil Company No. 1 Curry, about 2½ miles north of the North Dill pool in Okfuskee County, appears to be a pool opener. Situated in SE NW SE of 2-12-8, the test cored the producing formation from 3492-3500 ft. in the Cromwell sand.

▶ **Texas.** A drillstem test at 4955-77 ft. recovered 1000 ft. of pipe line oil from Pure Oil Company No. 1 Tom Williams, northwest of the Refugio field. The test appears due to open a new pool in the eastern extremity of Bee County.

▶ **Louisiana.** Reports from the Mid-Continent Oil Company's Tremont Lumber Company wildcat well in section 31-15-3, Jackson Parish, indicate a new oil producing area for north Louisiana. After perforation of casing and use of acid, a flow of water, gas, and oil came from about 7300 ft.

▶ **Texas.** Henderson field is the name of a new pool four miles north of Henderson. The discovery well, Beacon Oil and Refining Company No. 1 Allen, is said to have produced 250 bbl. in a 24 hr. test. The hole is drilled to 7500 ft.

▶ **Illinois.** National Associated Petroleum Company No. 1 Tork-Tibbs, NEC NW of 35-4s-7e, discovery well of the Bungay area of Hamilton County, flowed 628 bbl. of oil and 2 percent water after plug was drilled in the Aux Vases sand at 3282-3300 ft.

▶ **Indiana.** A. C. Thomas No. 1 Bailey, CSW SE of 28-4s-13w, has opened the Reyburn pool of Posey County. It pumped 150 bbl. from the Waltersburg sand at 2183-97 ft.

▶ **Kansas.** Morton and Adair et al., are giving McPherson County a new producing area at the No. 1 Paden, C SW SE of 10-18-1w, 3½ miles south of the Crowther pool. Some 1000 ft. of oil stands in the hole, which is 2750-70 ft. in chat.

▶ **Kansas.** Lion Oil Refining Company No. 1 Chitwood, NE SE NW of 23-28-12, is an official pool opener in Pratt County. It was completed for a temporary daily potential of 25 bbl. from the Simpson sand at 4399 ft.

▶ **Oklahoma.** Gulf Oil Corporation No. 1 Hopkins, 8-8-20w, is a deep test that opened a pool for Washita County. Twenty-six miles from the nearest production, it made a flow of oil of between 85 and 150 bbl. daily on a drillstem test. It has drilled past production for further test and is now below 8621 ft.

▶ **Kansas.** A good producer is the pool opener No. 1 Fesler, NWC 25-9-21, in Graham County. Operated by Hollow Drilling Company, it is making 1904 bbl. daily from the Arbuckle lime at 3766 ft.

▶ **Indiana.** Gibson County was given a new pool by George and Rather No. 1 McLin, NE NW SE of 4-1e-12w, when it pumped 40 bbl. from the Cypress sand at 1982-93 ft.

AVERAGE CRUDE OIL PRICES

California		Louisiana	
Kettleman Hills	$1.23-1.29	Rodessa	$ .88-1.20
Playa Del Rey	.80- .87	Gulf Coast	.93-1.36
Coalinga	.73-1.13	North Louisiana	.98-1.30
Wilmington	.68-1.24		
Montana	1.00-1.15	Illinois	1.22-1.37
Wyoming	.45-1.15	Kentucky	1.32-1.43
Colorado	1.05-1.07		
New Mexico	.70-1.15	Indiana	.85-1.25
Texas		Ohio	
North Central	.97-1.25		
Panhandle	.70-1.12	Lima	1.50-1.60
West Texas	.80-1.27	Michigan	1.24-1.44
Gulf Coast	.93-1.48		
Darst Creek	1.14	Pennsylvania	
East Texas	.80-1.27	Bradford	3.00
Talco	.79	Southwest	2.65
Kansas	.93-1.25	Eureka	2.59
Oklahoma	.75-1.25	Buckeye	2.30
Arkansas	.94-1.36	Corning	1.31

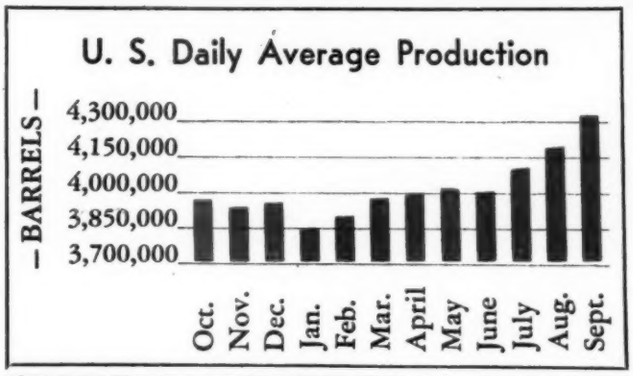
DAILY AVERAGE CRUDE OIL PRODUCTION
Data Supplied by A.P.I.
(Figures in bbl. of 42 gal. each)

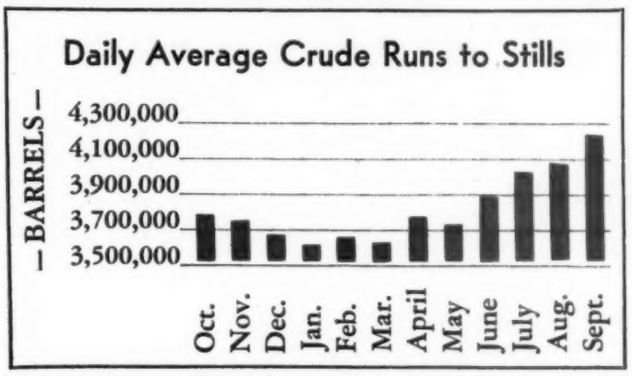
	[1]P.A.W. Recommendations September	Week Ended Sept. 25, 1943	Week Ended Aug. 28, 1943	Week Ended Sept. 26, 1942
Oklahoma	347,000	[2]325,250	326,200	368,550
Kansas	300,000	[2]296,150	297,600	296,900
Nebraska	2,000	[2] 1,800	1,800	3,300
Panhandle Texas		104,000	98,000	84,950
North Texas		140,600	140,400	137,950
West Texas		333,500	258,400	217,100
East Central Texas		131,200	129,950	86,450
East Texas		380,000	371,000	362,400
Southwest Texas		263,550	239,050	165,300
Coastal Texas		485,300	474,450	326,200
TOTAL TEXAS	1,909,000	1,838,150	1,711,250	1,380,350
North Louisiana		81,500	81,900	98,500
Coastal Louisiana		278,500	268,500	231,550
TOTAL LOUISIANA	375,000	360,000	350,400	330,050
Arkansas	80,100	76,300	76,350	73,000
Mississippi	50,000	48,850	52,200	73,400
Illinois	222,800	215,450	211,800	262,350
Indiana	13,800	14,400	14,700	16,750
Eastern (Not incl. Ill., Ind., Ky.)	86,600	75,200	73,950	83,550
Kentucky	25,500	24,650	22,600	11,900
Michigan	60,100	56,400	56,950	63,000
Wyoming	98,800	102,950	96,850	94,950
Montana	23,300	21,750	21,350	21,700
Colorado	6,500	7,050	7,300	6,600
New Mexico	116,600	109,350	105,050	97,900
TOTAL EAST OF CALIF.	3,717,100	3,573,700	3,426,350	3,184,250
California	835,000	770,700	769,900	724,800
TOTAL U. S.	4,552,100	4,344,400	4,196,250	3,909,050

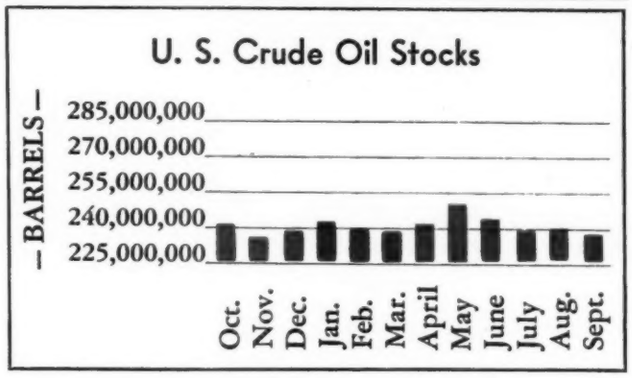
[1]P.A.W. recommendations and state allowables represent the production of all petroleum liquids, including crude oil, condensate and natural gas derivatives recovered from oil, condensate and gas fields. Past records of production indicate, however, that certain wells may be incapable of producing the allowables granted, or may be limited by pipe line proration. Actual state production would, under such conditions, prove to be less than the allowables. The Bureau of Mines reported the daily average production of natural gasoline and allied products in June, 1943, as follows: Oklahoma, 27,000; Kansas, 4,900; Texas, 106,400; Louisiana, 19,300; Arkansas, 4,000; Illinois, 11,500; Eastern (not including Illinois, Indiana or Kentucky), 6,000; Kentucky, 2,200; Michigan, 100; Wyoming, 2,000; Montana, 300; New Mexico, 5,400; California, 46,000.

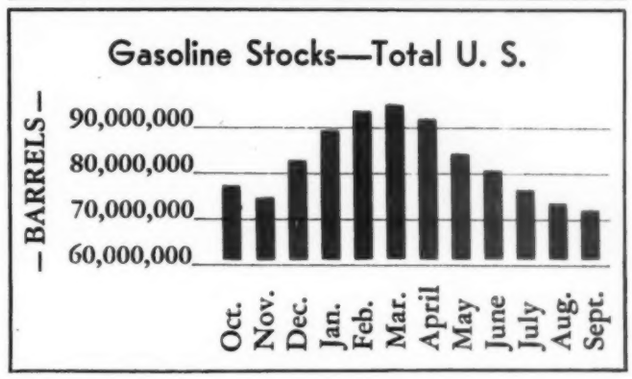
[2]Oklahoma, Kansas and Nebraska figures are for week ended September 23, 1943.

PETROLEUM *Statistics* AND FIELD *Operations*









Above statistics by American Petroleum Institute.

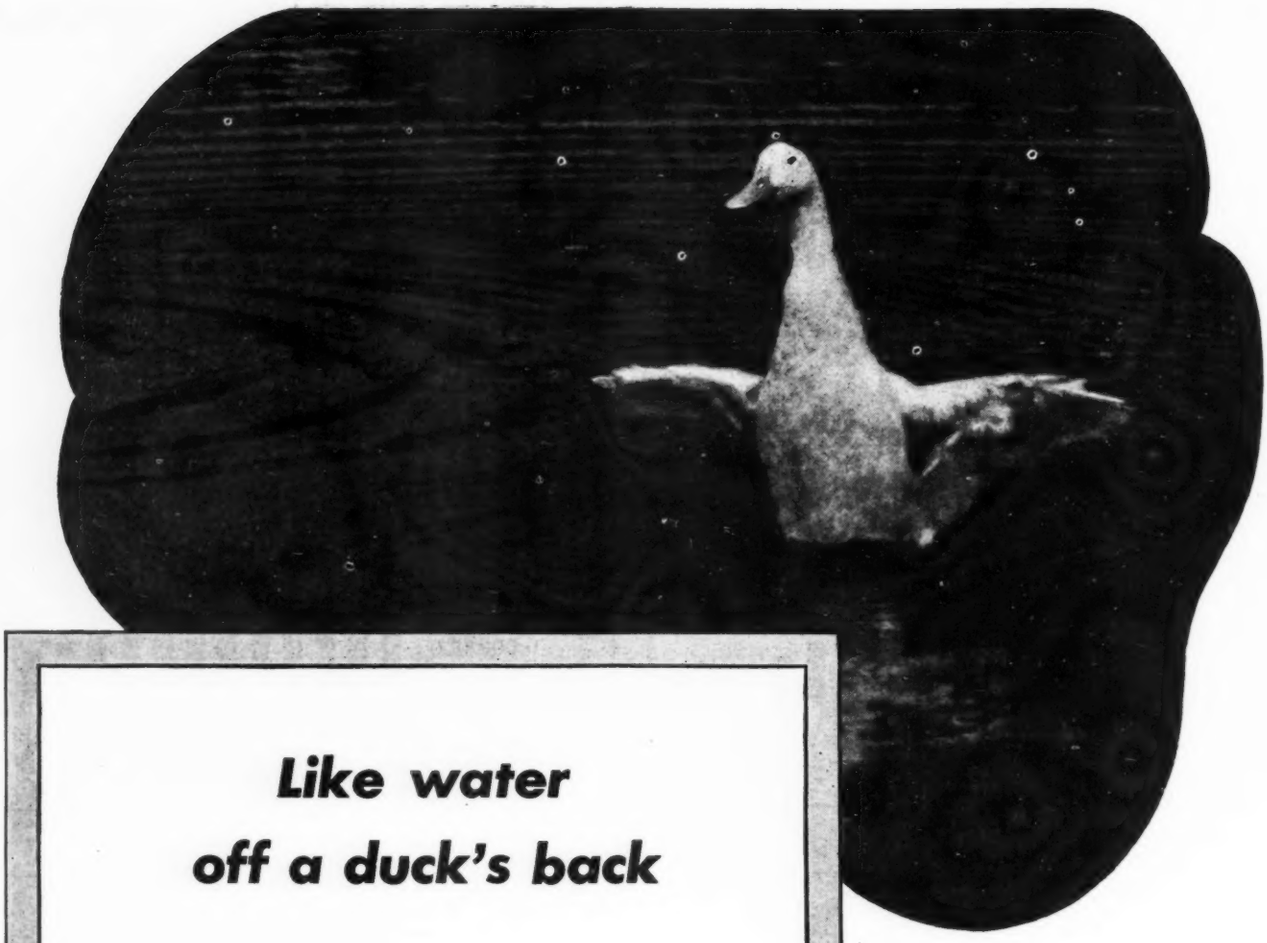
Summarized Operations in Active Fields for September, 1943

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
TEXAS								
Eastern Texas	19	14	4	....	3500-3700	2	40	Rotary
Gaines County	4	3	6	....	4400-5584	2	22-35	Rotary
Hockley County	10	7	7	....	4800-6850	2	20-30	Rotary
Ector County	9	7	5	....	3675-4377	2 or 3	32-36	Rotary
Panhandle	11	8	5	....	1700-3900	2	40	Rot.-Cab.
Nueces County	7	5	6	....	3922-5878	2 or 3	21-54	Rotary
K. M. A. Field	2	2	2	....	3730-3935	2	42-43	Rot.-Cab.
Hawkins Field	3	2	4	....	4495-4912	2	19-29	Rotary
OKLAHOMA								
Okfuskee County	4	3	6	....	2150-4125	2 or 3	38	Rotary
KANSAS								
Russell County	5	4	3	....	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	4	4	6	....	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	3	3	5	....	3290-3518	2	39-42	Rot.-Cab.
ILLINOIS								
Central Illinois	122	106	70	68	1425-4100	2	36-38	Rot.-Cab.
NEW MEXICO								
Lea County	5	4	5	....	3150-4030	2	30-34	Rot.-Cab.
CALIFORNIA								
Kern County	7	4	8	4	1840-11,450	2 or 4	14-30	Rotary
Wilmington County	3	3	4	4	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for September, 1943

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1942 (In Barrels)
	September	August	September	August	September	August	September	August	September	August	
Arkansas	18	25	16	15	12	14	10	10	18	20	26,560,000
California	85	146	76	118	46	53	28	44	24	52	248,250,000
Illinois	122	188	106	87	51	30	47	61	68	76	105,768,000
Indiana	42	37	33	24	13	26	3	6	6	11	6,680,000
Kansas	172	162	114	91	40	57	20	24	11	18	96,920,000
Kentucky	64	51	43	22	23	20	....	....	....	....	4,503,000
Louisiana	48	65	37	40	31	38	8	10	18	24	125,450,000
Michigan	53	66	45	38	29	24	12	15	....	20	21,568,000
Mississippi	3	6	....	2	....	....	....	....	....	....	27,605,000
Montana	20	18	14	11	....	....	....	6	....	....	8,998,000
Nebraska	3	....	2	....	2	6	....	....	....	....	1,367,000
New Mexico	16	20	12	10	21	14	....	....	....	....	31,875,000
New York	105*	110*	88*	110*	66	57	....	27	....	....	5,132,000
Ohio	73	90	67	45	39	36	....	22	....	....	3,480,000
Oklahoma	107	151	91	85	31	38	18	24	45	62	138,750,000
Pennsylvania	187*	252*	167*	246*	127	171	....	....	....	....	17,256,000
Texas	312	425	253	245	311	341	286	271	205	301	476,560,000
West Virginia	68	77	51	71	20	27	5	6	7	21	3,780,000
Wyoming	14	12	7	9	3	7	2	4	4	19	32,778,000
Total	1513	1899	1222	1269	819	959	439	530	406	624	1,383,280,000

*Includes water-intake and pressure wells.



Like water off a duck's back

A DUCK is just naturally waterproof. He's built that way. Being waterproof is his specialty. It enables him to do a lot of things that a chicken, for example, can't do.

Just as a duck sheds water, Hycar synthetic rubber sheds oil. For Hycar's specialty is oil-resistance. Particularly oil-resistance in the presence of heat, abrasion, pressure, or aromatic hydrocarbons. The oil-resistant types of Hycar are built that way. But the *degree* of oil-resistance is closely controlled, tailored to the job. Oil-swell can be held to ±1%, or even to zero. In addition, Hycar can withstand temperatures of 250°, abrasion resistance is 50% in excess of natural rubber, and compression-set characteristics are excellent.

Aren't these the qualities you have wanted in cargo and fuel hose, gaskets, seals, packers, diaphragms and other products you use? *Hycar Chemical Company, Akron, Ohio.*

Hycar is supplied in crude form to rubber fabricators. Because of its outstanding performance in war uses the demand far exceeds the supply. But now is the time to work out with your supplier of rubber products ways of obtaining Hycar for actual test in your own applications, both present and future. It's to your advantage to gain experience now against the day you will need new and even better rubber products. Our technical staff and laboratory are ready to help.

Hycar

LARGEST INDEPENDENT PRODUCER OF BUTADIENE *Synthetic Rubber* IN AMERICA

P 972.1

FOREIGN - POSTWAR PLANNING NUMBER

of

THE Petroleum Engineer

OCTOBER, 1943

Edited by
Wallace A. Sawdon
Foreign Editor

The World's Oil in Wartime

PETROLEUM ENGINEER Exclusive Feature

☆ Shortage of materials has restricted activity throughout the world, but oil power is preponderantly with the Allied Nations

by Wallace A. Sawdon

PETROLEUM and its many products will have a vital influence on the postwar world. Today, however, the world is at war, and the petroleum industry is playing a major part in the conduct of the war. The radio and newspapers are dramatizing the accomplishments of planes and tanks and ships, but without oil they could not operate. In fact, without oil the vast quantities of war materiél could not be produced at the astounding rate that has now been achieved. Even the natural gas produced with the oil is playing a vital part in the war effort.

In considering the present status of oil production in countries throughout the world, it must be remembered that, although virtually all the oil producing countries united against the Axis are supplying oil for the war effort, demands are drawing unmercifully on the reserves of some areas. This is particularly true of the United States, which because of its highly developed technique, its great production capacity, and its ability to ship oil despite hazards, has been called upon to supply a tremendous amount of aviation gasoline, motor fuel, and lubricants to the battle fronts. The war has thus depleted this country's reserves and at the same time has prevented normal exploratory work to augment those reserves. Military victories during the last year have made available petroleum supplies from other areas—areas closer to some of the battle fronts. To what extent these will be utilized to relieve production requirements in the United States cannot be foretold. Judging from predictions being made by the PAW, however, there does not seem to be much hope of this country being relieved.

Sawdon is a graduate of the University of Delaware—Joined the staff of the U. S. Bureau of Mines in 1922, previously having been a captain in the Engineer Corps during the first World War—Upon leaving the Bureau of Mines he became affiliated with the Independent Oil and Gas Company as a petroleum engineer—Later he engaged in consulting engineering work, was a sales engineer for The Foxboro Company, and field editor for *Oil Field Engineering*—For several years has been Pacific Coast and foreign editor of *The Petroleum Engineer*—Has had intimate and extensive contact with the petroleum industry throughout the world—Resides in Los Angeles, California.

The pressure of oil on the Axis is indicated by Fig. 1. The lines in this drawing show the countries producing the oil and not the routes of petroleum products to the fields of battle. The oil may be used in planes, tanks, or other motorized equipment, for war ships in combat or convoy; or it may be employed for the construction of instruments of war or insuring the supply of food. The oil from Mexico may go to the United States and replace other oil; or that from Peru and Ecuador may go to England or California. How much is going where cannot be told but it is all contributing to the war effort either directly or indirectly.

The total oil production of all nations that are contributing, or can contribute, to the pressure of oil on the

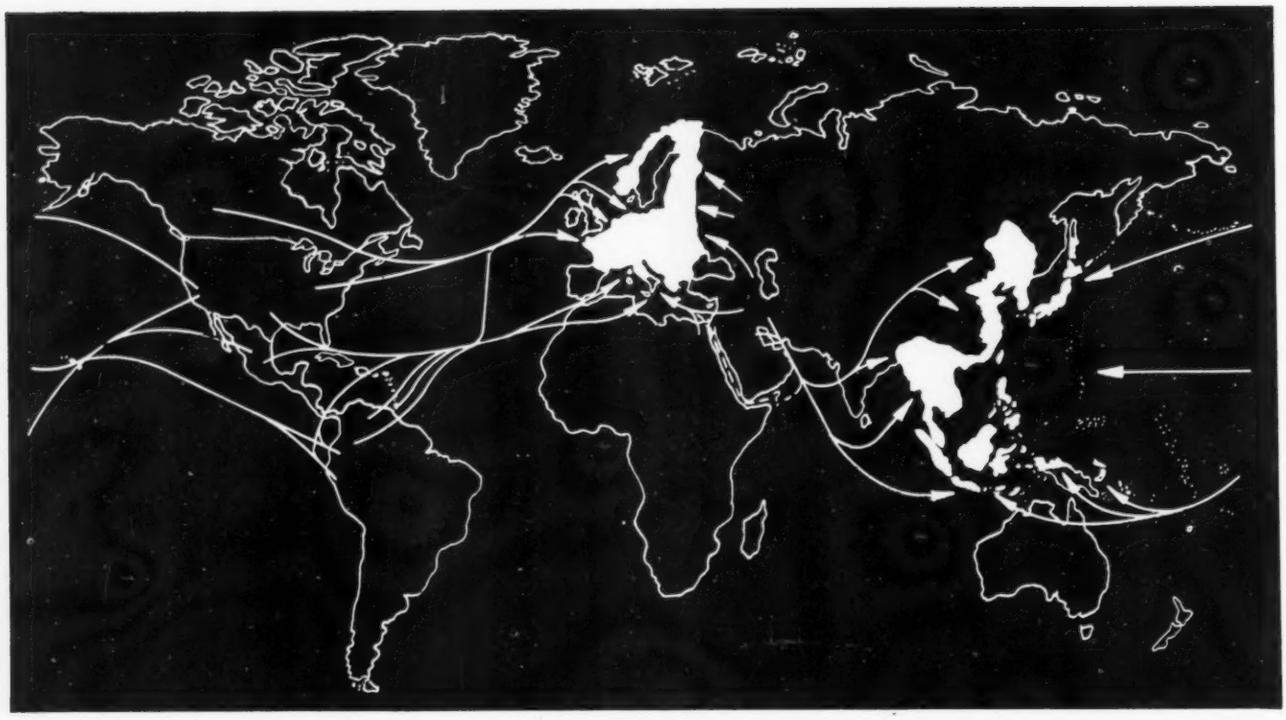


Fig. 1. Indicating the pressure of oil on Axis Powers. Lines and arrows show where oil is produced, not routes of petroleum products to the fields of battle

Axis is more than 6,000,000 bbl. per day. The oil production of that part of Europe controlled by Germany is estimated at a little more than 150,000 bbl. per day. Japan's production, including that of the East Indies and Burma, has been estimated as low as 48,000 bbl. per day but such a figure would appear to place too optimistic an appraisal on the destructive work performed on the fields of the East Indies and Burma prior to their capture. Before the Japanese invasion the daily production from these areas was nearly 200,000 bbl. per day and, although it is impossible to make any intelligent estimate of the production of Japan and her conquered oil producing territories, the actual producible quantity at this time is probably close to 100,000 bbl. per day. If the shipping facilities, refining capacity, and various other conditions imposed by the war permit the production and processing of this amount of oil, it would seem that 100,000 bbl. per day is available.

The preponderance of oil power held by the United Nations is thus evident. It is true that Germany has a great synthetic motor fuel industry and this synthetic fuel, plus a previously accumulated reserve supply of petroleum and petroleum products, enabled Germany to conduct her extensive military offensives in the past. It is also possible that synthetic motor fuels in addition to those made from coal have been developed and used extensively. Lubricating oils other than those made from petroleum have also probably been employed. The great reserve of petroleum and refined products stored up before the war must now be used up; in fact, it was thought more than a year ago it had then been consumed. Recent events, however, have given evidence that the motor fuel supply of Germany is now really in a precarious state—and in modern, mechanized warfare with its necessity for vast air operations, a nation without adequate petroleum resources cannot win.

The difference in oil power is not, of course, expressed by the ratio of 6,000,000 bbl. per day for the United Nations to 150,000 bbl. for Germany and 100,000 bbl. for Japan. Germany is probably using the maximum percentage of the oil she takes from European fields for conduct of the war and is augmenting her production by great quantities of synthetics. Yet only 10 percent of the United Nations' available supply will far exceed the total for Germany and Japan. Moreover, a great portion of the petroleum not employed in actual combat by the United Nations is used indirectly for war purposes and the more general utilization of petroleum products in countries distant from war zones not only facilitates manufacture of materiél and supply of food but also helps to maintain morale. In a nation such as the United States, which is so dependent on transportation facilities, the use of petroleum products to maintain that transportation system with its widespread ramifications is a definite part of the oil power being exerted on the Axis.

The oil supply of Germany is probably decreasing, both from natural causes and from military action. How effective the bombing of fields and plants has been is still a matter of conjecture but it certainly has done some damage. Had Germany procured the production of the Caucasus, her oil supply would have been increased by more than 400,000 bbl. per day and, because there is a limit to the volume of petroleum products that can be effectively employed (dependent for one thing on the equipment in service to use petroleum products), the oil power of the United Nations would be somewhat nullified and oil would not be the vital factor of the war as it is today. Russia, on the other hand, had preponderant oil power for her resistance to Germany and it was probably one of the most effective factors in the success of Russia's defense and subsequent offense.

Approximately 70 percent of the

production of German controlled Europe comes from the Rumanian fields. It is estimated by some that Rumanian production declined from 38,000,000 bbl. in 1941 to 34,000,000 in 1942. This would be a slight acceleration of the decline that has held consistently since 1938. Others believe, however, that production from Rumania was approximately the same in 1942 as in 1941 with a possible slight increase. Whatever the production rate has been during the present year there is every reason to anticipate further bombings of the Rumanian fields, which should result in a considerable reduction of production. This should bring a crisis in Germany's entire war effort and might conceivably be a direct cause of capitulation.

The position of Japan is somewhat different. Because of the character of the warfare to be waged, her oil supply is, or could be made to be, more nearly adequate for the defense of her conquered territory so long as transportation can be maintained. By cutting the sea lanes to the East Indies and by taking Burma, Japan's oil power could, however, be reduced to a precarious point. Should this happen, the vital character of oil power would come into effect and might in itself cause Japan's defeat. Regardless of what strategy is used in conquering Japan, there is sufficient oil power available to move against her with ships, planes, submarines, and ground equipment of any and all kinds.

World Activities

Due to the shortages of material during the last four years activities in fields throughout the world have been restricted. In some fields further immediate development work has not been important; in others it has hampered production seriously. In most areas equipment has necessarily been allowed to deteriorate from the standpoint of efficiency; and extensive replacements and additions will have to be made when the war is over. Exploratory work obviously has been curtailed for the time being but the importance of petroleum reserves as disclosed by the war and as indicated by the expected increase in oil consuming industries and equipment will undoubtedly stimulate geological and geophysical prospecting to locate a wider distribution of producing areas as well as to intensify the productive capacity of areas of known prospects.

Because of war restrictions definite information on present activities in many countries cannot be published. In countries such as Russia these activities are clothed in secrecy and no reliable data on drilling, production, or refining are available. Production in Russia, exclusive of Sakhalin Island, for 1942 has been estimated at 210,000,000 bbl. This is a drop from the estimated production of 238,150,00 bbl. for 1941 but the rate of production may now be back to the average of the last few years. The Kuban-Maikop fields taken by the Germans have been recaptured but whether any work has been done to put those fields back on production is not known. The volume of oil from these fields is not necessary for the total requirements of the country but the location of the fields may have made their rehabilitation desirable.

The pipe lines in the Caucasus have probably been repaired and the distribution system in the southern part of the country undoubtedly has been facilitated to meet the demands of the war effort in that territory. Baku, producing more than 70 percent of Russia's oil, was not affected by the German conquest nor were the Ural-Volga fields lying east of Moscow. It is doubtful whether further exploratory or development work of any extent has been done in the Ural-Volga area since the Russian victory at Stalingrad when all threat to the Baku and Gorzny areas was eliminated.

Production from Sakhalin Island is believed to have remained at approximately 4,000,000 bbl. per year, a figure estimated for that island for the last several years. Japan still holds the southern part of the island only and agreement between Russia and Japan appears to be unchanged. Where the oil from northern Sakhalin goes at this time is not certain.

No new development has been reported in Russian Asia and probably geological and geophysical work is not being pushed in that vast territory.

China

Near the center of Asia and in the northern part of China, the Great Wall of China ends. A little to the northwest of this point, oil has been discovered. Several wells have been drilled, the earlier ones by Chinese using cable tools. At least one rotary rig is now reported in operation. Little authoritative information regarding this development can be published at this time but the drilling is being done with the aid of American supervision. The location was made by oil seeps and the wells have been drilled down structure from the seeps. Some pressure has been encountered in some of the deeper holes and control equipment has recently been installed to prevent blowouts.

How much oil is being produced and where and how it is being transported is not disclosed. The field is in the southern part of the Gobi Desert and not far north of the "trade route" that runs northwest through Liangchow and on in a general westerly direction nearly to Lake Balkhash in the U.S.S.R. The earlier rigs were probably carried in from the nearest point accessible to conventional transportation by the astounding Chinese method of moving heavy machinery to remote locations. Recent shipments of equipment have been made by plane from India.

The Middle East

Production in India has been increased slightly and is estimated at 2,500,000 bbl. for 1942 as compared to 2,270,000 for 1941 and 2,250,000 for 1940. The threat of Japanese capture of the Digboi field in Upper Assam is now far less than it was a year ago and both this area and that of the Punjab are considered comparatively safe.

Interest in the Burma fields is not in what they are producing for Japan but what they will produce after recapture. It has been estimated that the production of Burma in 1942 declined to approximately 2,500,000 bbl., a drop from an average of 7,750,000 bbl. during the preceding two years. The actual production is, of course, unknown but has probably been influenced by the demand in that sphere of operations and by the facilities for producing and refining the crude oil available. The destructive work in Burma just before invasion was probably more effective than that carried out in the East Indies; but rehabilitation by the Japanese in Burma has probably made little progress.

Oil equipment likely will be made available for use as soon as the reconquest of Burma is begun; and rehabilitation of the fields should follow closely military successes. Operations in the Irrawaddy River fields will probably include the drilling of many new wells to replace a great number that will be abandoned because new wells, in many cases, will take less time to drill than trying to put old wells back on production. Spark plug rigs, many of the portable type, will probably be used extensively throughout the fields.

The Near East

The Near East should play an important role in supplying oil power for final military action in both the European and Japanese theaters of war. Here are the fields of Iraq, Iran, Bahrein Island, Saudi Arabia, and Egypt. Except for Bahrein Island, which has been virtually drilled up in its present productive zones, all these countries showed at least a slight increase in production in 1942. This increase does not, of course, indicate the productive capacity of the fields, many of which have never been produced at maximum rate and some of which are not much more than undeveloped discoveries of known extensive reservoirs.

Production of Iran is estimated at more than 73,000,000 bbl. for 1943, an increase of 10,000,000 bbl. over the previous year although not as much as the high of 78,000,000 bbl. produced in 1939. Except for a small skimming plant at Kermanshah, crude to be processed in Iran goes to the 280,000 bbl. per day refinery at Abadan and the smaller 50,000 bbl. plant at Bandar Ahapur, the former being a complete refining operation and the latter a skimming and cracking installation. These two refineries are situated at the head of the Persian Gulf and refined products, including aviation fuel, have free access to points on the Indian Ocean. Shipments for use against Japan naturally require protection but petroleum products for naval action are thus readily accessible. If necessary, shipments can be made to Europe through the Red Sea and the Suez Canal.

With the Mediterranean now clear, production from Iraq should be available for use in Mediterranean operations. Pipe lines from the Kirkuk field, one to Tripoli in Syria and the other to Haifa in Palestine, can now be utilized to the extent that oil transported through them can be processed. At Haifa is a 40,000 bbl. per day skimming-cracking plant with a 20,000 bbl. per day cracking capacity. This refinery was bombed earlier in the war but it has probably been repaired; in fact, most likely it remained in operation during the time of the African campaign and supplied fuel for that operation.

Bahrein Island probably has been producing at a slightly declining rate from the total of 6,800,000 bbl. of 1941. Here is a refinery having a capacity of 32,000 bbl. per day with cracking capacity of 12,000 bbl. per day. Lying in the Persian Gulf, its products are available to the same uses as those from the refineries at the head of the Gulf. As production from Bahrein Island does not provide enough crude oil for full capacity of the refinery, production from the mainland of Saudi Arabia is transported to this plant.

Production from Saudi Arabia is approximately 6,000,000 bbl. per year, about the same as it has been for the last two years. This is in no way indicative of the possible production of the area lying back of the coast of the Persian Gulf. In addition to the older Damman field there are other fields of great extent that have been little more than proved. Little can be said of these fields at the present time. It is expected that their development will begin in the near future and that a refinery of considerable capacity will be constructed at a suitable point on the Persian Gulf. The plans consider mainly postwar operations.

Egypt's production increased to approximately 9,000,000 bbl. in 1942, more than 2,000,000 bbl. above the average for the previous two years. There are two refineries at Suez having a total capacity of 18,000 bbl. per day, the larger having a cracking capacity of 4,000 bbl. per day. Products from here probably played their part in the North African campaign.

South America

The fields of the northern South American countries, particularly Venezuela, have been contributing to the oil power of the United Nations to the extent that transportation has made possible. Full production capacity has not been utilized because of the submarine menace but with greater control of U-boat activities it is reasonable to anticipate more extensive use of South American oil, both directly and indirectly, in the war effort. Larger shipments to the United States from both Venezuela and Colombia would alleviate the shortage of certain products, particularly on the East Coast, and at the same time would aid those countries that have suffered severely from curtailed exports for a long period.

Authoritative production figures for Venezuela have not been made available for publication for 1942 and 1943. The high production point was reached in 1941 with a total production of 223,784,000 bbl., a daily average of more than 600,000 bbl. that passed 700,000 bbl. per day toward the end of that year. This declined to a very low point during 1942 but during the first half of the present year increased to between 400,000 and 500,000 bbl. per day. What the production is at present has not been reported but it is hoped that it will pass the 700,000 bbl. mark in the near future.

In considering these production figures it must be remembered that the potential production of Venezuela has been increased since the high of 1941 was reached. Moreover, much development work is planned and will be inaugurated when equipment becomes available. With the great potential production that can be expected in the near future Venezuela will probably be shipping petroleum and refined products throughout the world. Greater refining capacity will be necessary on the mainland and new refinery construction and expansion can be expected, particularly in Eastern Venezuela.

Colombia has been in a position somewhat similar to Venezuela so far as curtailment of production due to the influence of war is concerned. Although its daily rate of production reached a high mark early in 1942, the annual production for that year has been estimated at between 10,000,000 and 11,000,000 bbl., which was a considerable decline from 24,500,000 in 1941 and 25,600,000 in 1940. During the latter part of 1942 and the early part of the present year production declined greatly but from latest reports has now increased sharply. Here, too, new production has been made available since the high production point was reached and, although actual field development will not be so extensive as in Venezuela, there is every reason to believe that the country's potential will be appreciably increased.

Production from Ecuador in 1942 increased slightly over that of the previous year and returned approximately to that of 1940 when the total was a little more than 2,000,000 bbl. During the present year production may have declined slightly.

Production from Peru increased to an estimated 13,600,000 bbl. during 1942 and the present daily production from the fields south of Talara alone is reported now at more than 30,000 bbl. The refining capacity of the plant at Talara is 20,000 bbl. of crude oil per day with cracking facilities for 7,000 bbl.

Brazil is still actively prospecting for oil and the Bolivian fields continue to produce more than 200,000 bbl. per year.

Argentina continues development work and is further progressing toward self-sufficiency in petroleum resources. This work has naturally been influenced adversely by war conditions, particularly by lack of equipment from the United States upon which great reliance has heretofore been placed. Quoting from the report on "Petroleum Development in Argentina During 1942" by Mario L. Villa, Gerente General, Yacimientos Petroliferos Fiscales, published by the A.I.M.E. ("Transactions, Petroleum Division, 1943"), "The possibility of manufacturing oil equipment in this country is being studied; in fact, plans for the manufacture of mud pumps, drill collars, slips, drag bits, and miscellaneous spare parts are well under way. Pumping units built in Argentina are already working."

Production of Argentina in 1942 was 23,742,000 bbl., which was an increase of almost 8 percent over the 22,013,000 bbl. produced in 1941. Approximately 70 percent of the total production was from the Comodoro Rivadavia district.

Trinidad showed a definite increase in production during 1942 with an estimated 25,700,000 bbl.—the greatest volume of oil yet taken from that island. This compares with 21,000,000 bbl. in 1941 and 20,000,000 bbl. in 1940; and is a continuation of a steady rise in production since the discovery of oil in 1908.

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Foreign Oil and Postwar Planning

☆ Oil industry seems destined to assume a world-wide pattern and policies now being formulated should consider the best interests of all, both here and abroad

by K. C. Sclater
Editor

UNDER what conditions will foreign oil operations be conducted after the war? This is a highly pertinent question inasmuch as new international oil policies are now in the making. If it were possible to give an answer to this question now, it would afford the industry a clearer view of its postwar problems and aid in their appraisal; also, it would provide a basis for sound postwar planning. Concentration on war work has given the industry little opportunity to give much consideration to postwar problems. All its energies have been, and will continue to be for the duration, bent on keeping our fighting forces and war industries and those of our Allies adequately supplied with vital petroleum products. This is as it should be. International oil trends in recent months, however, are such that the oil industry cannot afford to be too complacent about what is taking place.

It becomes increasingly clear that the manner in which foreign oil operations will be conducted after the war will depend on the policy the government will follow with respect to the development of oil deposits in foreign countries. What that policy will be or whether a definite foreign oil policy has been decided upon is not known; if it has, it has not been officially announced.

The creation of the Petroleum Reserves Corporation in June of this year is evidence that the government plans to assume, at least for the duration, some form of government participation in foreign oil development. Further evidence of this is the issuance of PAW Directive 70, the provisions of which fit into the plans of the Petroleum Reserves Corporation. Just what the ultimate plans of the Petroleum Reserves Corporation are have never been divulged. Secrecy has surrounded the Petroleum Reserves Corporation's activities since it was created, and this has given rise to much speculation and not a little apprehension.

Petroleum Administrator Ickes, who is president of the Petroleum Reserves Corporation, until a few days ago refused to reveal, on the grounds of military secrecy, any information regarding the program and activities of the Corporation. When he did make a formal disclosure in this connection he said that "Preliminary studies have been completed and solid groundwork has been laid for more comprehensive action looking toward an increasingly efficient utilization of foreign petroleum facilities for the fighting forces abroad and closer integration of foreign production and distribution into our domestic supply pattern.

"It is now necessary to undertake studies in the field to perfect our information from firsthand surveys and observations. The PRC, whose directors are secretaries of State, War, Navy, Interior, and the Director of Office of Economic Warfare, made arrangements several weeks ago to send a mission to the Middle and Near East oilfields."

Since the Petroleum Reserves Corporation has been formed it has been working behind the scenes on the problem of oil production, refining, and distribution facilities in the Middle and Near East. The PAW, through its Foreign Operations Committee, is simultaneously engaged in accelerating oil operations in foreign fields.

Scope of PRC

According to the charter of the Petroleum Reserves Corporation its powers are broad in scope. It was created under the Reconstruction Finance Corporation Act on June 30, 1943. The objects and purposes of the Corporation as stated in the charter "shall be to buy or otherwise acquire reserves of crude petroleum from sources outside the United States, including the purchase or acquisition of stock in corporations owning such reserves or interests therein, and to store, transport, produce, process, manufacture, sell, market, and otherwise dispose of such crude petroleum and the products derived therefrom; and the Corporation shall have the power and authority to do and perform all acts and things whatsoever necessary thereto, including, but without limitation, the power to borrow money and issue its secured or unsecured obligations therefor; to adopt and use a corporate seal; to make contracts; to sue and be sued; and to construct and operate outside the United States such refineries, pipe lines, storage tanks and other facilities as are necessary in connection with carrying out the objects and purposes of the Corporation as above stated." Although the total authorized stock is declared to be one mil-

lion dollars, it has unlimited borrowing power.

The course of action the Corporation will pursue has great significance. It may be far-reaching in its effect on foreign oil development operations in the immediate postwar period.

Judging from the plans as they have thus far developed the course in world oil on which the United States has embarked covers every phase and branch of the petroleum industry. The PRC through the State Department has the power to deal with foreign governments on petroleum matters.

The further fact that the Foreign Operations Committee of the PAW is also engaged in coordinating foreign oil activities is indicative of the extensive participaton of the government in forwarding war plans connected with foreign oil problems.

Postwar settlements will be concerned with the access of the various nations to raw materials, of which petroleum is one of the most important. Foreign oil operations are therefore entering a new phase.

The Postwar Era

In the postwar period, the oil industry will witness an era of greater activity and greater competition in foreign oil than it has ever known before. This is one good reason why international oil trends should not be overlooked by the oil industry at large. What trend foreign oil settlements will take are closely related to postwar planning in the oil industry both at home and abroad. They will be more closely tied-in with domestic oil development and for this reason the oil industry will have to develop a world-wide viewpoint on oil matters.

Petroleum as a natural resource and an essential raw commodity in nearly every country of the world is of such paramount importance that it will be the subject of the closest study in postwar settlements. The oil industry of the United States may find that it must fit its operations into the pattern of world economics. Any program embarked on by a private oil company operating in foreign fields will have to stand the test of scrutiny not only by the United States government but by the governments of other nations. Cognizance will have to be taken of other countries and their economic status.

What course world settlements will take with respect to natural resources is not known, but there will have to be a "give and take" attitude among nations. Political questions and economic considerations will enter, but they should not be confused one with the other. As the world oil situation begins to take more definite shape, including the preparations the U. S. government has in progress for controlling foreign oil operations during the war, there is a lurking fear that the extension of government control to foreign operations may be extended into the postwar period. There is no definite assurance even that government control of domestic oil operations will be discontinued following the close of the war, or that private enterprise will replace government bureaucracy immediately the war ends.

Far-reaching effects are likely to be felt by domestic oil operations in having to conform its activities to meet international conditions in the postwar era. Fuller utilization of petroleum and its products may be necessary to prevent undue dissipation of domestic crude oil reserves. Failure to observe this point may invite large importations of foreign oil.

Pogue, in a paper elsewhere in this issue, points out that for the duration of the war the American petroleum industry has become indissolubly linked with foreign sources of supply and that no major oil problem can now be resolved except in the light of all foreign alternatives. He also points out that the manner in which the petroleum resources of the world are disposed of in the postwar era will play a large part in the economic and social progress of nations. These are factors to be borne in mind when the question of a foreign policy is under consideration. Pogue states that our oil policy must be such that it will not only serve the interests of the nation, but that it will also further the productive capacity and volume of trade of foreign countries. He states further that there should be a freedom from burdensome operating controls, stability of contracts, and parity with all competitors. "If these conditions are provided with international understanding this country and its petroleum industry can make an outstanding contribution to the future stability and well-being of the entire world."

Effect on World Trade

Oil's place in the postwar world and its effect on world trade therefore merit the closest study today when foreign oil policies are being developed and commitments being made.

Postwar plans for the oil industry must take into account the vast losses of crude oil stocks that have occurred in war and also the accelerated consumption of petroleum products in carrying on the war. In addition, there is the devastation of oilfields, refineries, and other petroleum facilities; these all must be replaced. The rehabilitation and reconstruction problems that confront the oil industry are tremendous, and are world-wide in scope.

In the United States alone a vast exploitation program will be necessary in the postwar period to increase the Nation's oil reserves. There will also be a great need for replacement of equipment in the field, plant, and refinery. In the immediate postwar period the oil industry in all its branches will be taxed to the utmost in meeting the problems that now confront it. Many new competitive factors will arise in the postwar era. There will be drastic changes in refining processes and products. There will be increased competition from other countries. There will be the need for new designs in equipment. It is hoped that there will also be a wise foreign economic oil policy that will conform to the best interests of the oil industry, here and abroad.

Period of Transition

The period of transition from war to peace will provide an opportunity to discard inefficient practices and equipment that can be replaced by modern methods and materials. Many new conditions will be met that will render useless past performances and experience. Many other questions arise: Will the petroleum industry of the United States be prepared to resume dominant leadership in petroleum when the war ends? What will be the changes in purchasing arrangements with foreign countries? Where will oil exploration be pushed, here at home or in foreign fields? What changes in machinery and equipment may be expected? What about war substitutes? Who will operate the Big-Inch line after the war? What effect will the Big-Inch and other war emergency lines have on the location of refineries and manufacturing facilities? When all oil tankers are released how will it affect trans-continental and world commerce? What about increased capacity for high octane gasoline after the war? Will commercial and air transportation grow fast enough to absorb all this product or will it necessitate drastic changes in auto engine design? What part will synthetic fuels play in the postwar era? What about synthetic rubber facilities? What about drastic changes in refining technology? Will the industry be allowed to conduct its own operations here and abroad with minimum governmental control?

These are among the important questions that will come up for solution in the postwar period. They are all closely related and hinge on the policy the government will adopt in regard to foreign oil. A wise foreign oil policy will accomplish the transition from war to peace in the oil industry with a minimum of dislocation and preserve the well-being of the oil industry and particularly those companies operating in foreign fields.

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Our Future Oil Supply

☆ Intensified exploration, and withdrawal at rate conducive to greatest ultimate production, important economic factors

by J. E. Brantly

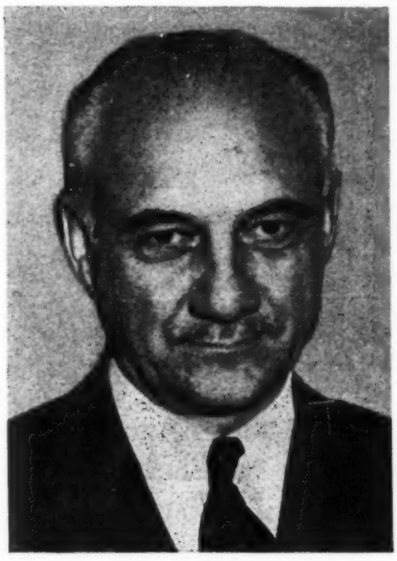
President, Drilling and Exploration Company, Inc.

OUR entire economy—social, political, and industrial—is so intimately related to petroleum that America cannot function normally without a sufficient flow of this resource from wells here or elsewhere and without adequate quantities of its derivatives produced by American refineries. This was true prior to the beginning of this great war, it is true now, and without question will be doubly true succeeding it. The rapid rehabilitation of the nations of the earth will be largely dependent upon oil and it will be essential to the progress or continued progress of their peoples. Our country is strong because of its transportation systems, which give ready accessibility to all its resources, and because of the speed with which its personnel and products can be assembled and moved. Petroleum plays a major part in these movements of men and materials. Without it we would revert to horse-drawn movement of products of the farm and forests and factory to steam or electric railroads and the internal-combustion engine with its multitudinous uses would not have been built. The air above us would still be unknown except to the balloonist.

It is essential that we preserve and conserve our resources of this all important product of the earth and that we find new sources of supply. Our presently known supply is definitely limited—whether the remaining reserve be 20,000,000,000 bbl. or twice that amount it is still definitely limited—and we are now using 1,500,000,000 bbl. annually. We expect and intend that these United States shall continue as a great nation, leading in the progress of mankind for many, many generations yet to come. Oil is a crucial factor.

Beginning of Petroleum

Petroleum or "rock oil" was first produced from a well, made by drilling a hole into the crust of the earth to a depth of 67 ft., in 1859, near Titusville, Pennsylvania. Oil and asphalt from seepages and springs had been known and used for various purposes for thousands of years before and even



J. E. BRANTLY

is a native of Georgia—He studied geology and mining engineering at the University of Alabama, where he later became an instructor—Subsequently he became state geologist of Georgia—At the end of the first World War, in which he saw service, he opened an office in the Mid-Continent as a consulting geologist—Later, as chief geologist of the Atlantic Refining Company, he devoted much attention to geological and geophysical surveys in Mexico and South America—In 1929 he organized and has since been president of Drilling and Exploration Company, Inc., Dallas, Texas, and Los Angeles, California—In addition to activities in the United States, he has engaged in extensive operations in Colombia, Venezuela, Trinidad, eastern Canada, Peru, and Brazil.

shallow wells had been dug, but until the first well at Titusville, there had never been a sufficient quantity available to permit or justify the building of an industry around it, even though many of its useful qualities were well known.

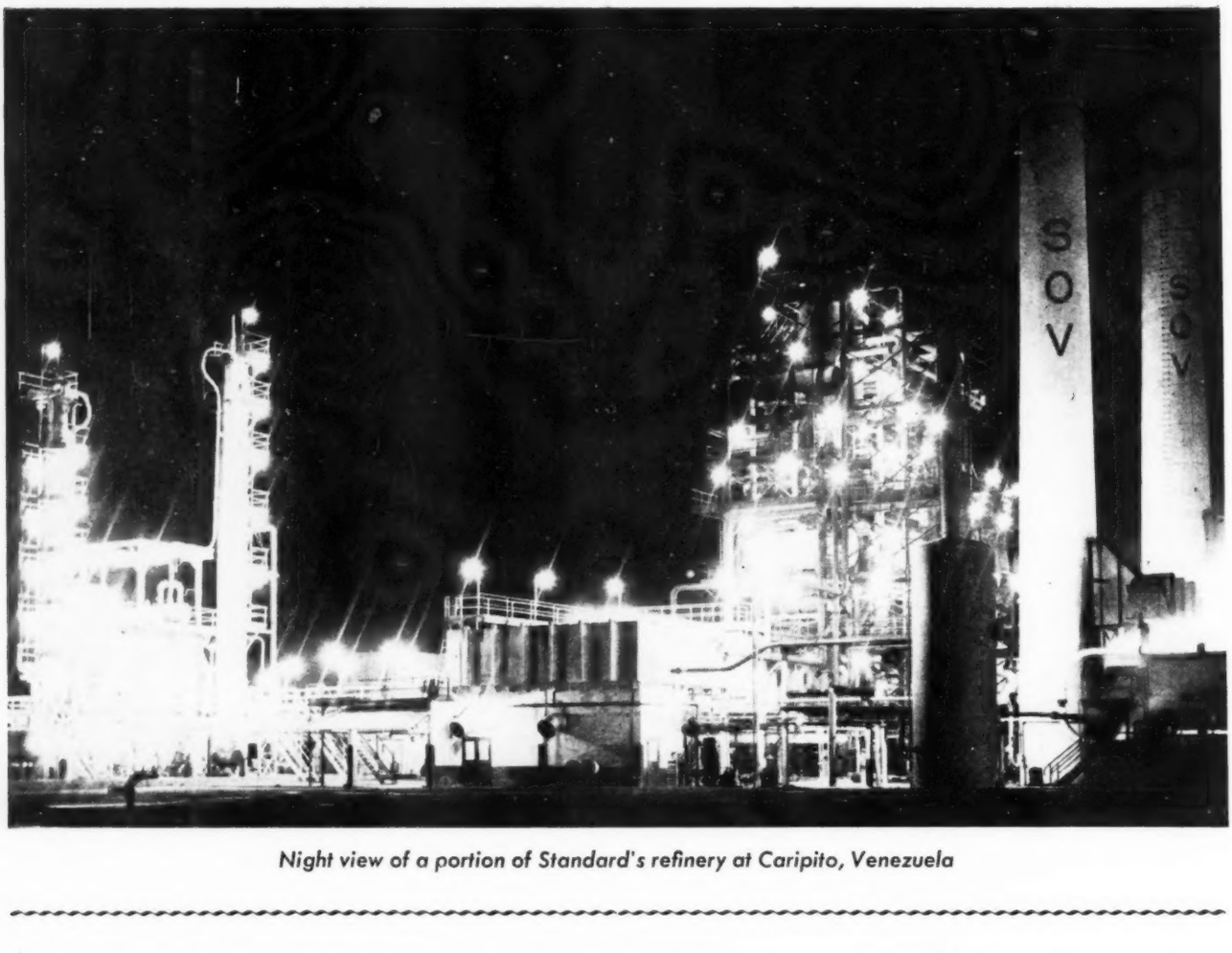
With the development of the internal-combustion engine the situation again changed. The rapid increase in demand, together with a satisfactory price, gave the necessary incentive to the industry to increase its daily production in the amount needed and to establish reserves for future withdrawals. These would assure the enormous industries established around automotive equipment that their products would have sufficient supplies of lubricants and fuels for a number of years, even though the industry could no longer replace reserves as used to supply the demands on it. In 1903, the industry produced 100,000,000 bbl. of oil for the first time. Geology and petroleum engineering had not reached the point of development in those early years where they could be used to make reasonably satisfactory estimates of reserves.

In 1916, a few years after the perfection of the gasoline engine, when it was being made available to large numbers of our citizens, the industry produced 300,000,000 bbl. of oil. At that time the reserve was estimated at 4,000,000,000 bbl. In 1929 the industry first produced 1,000,000,000 bbl. of oil in one year. At that time our reserves were estimated at 10,000,000,000 bbl. With the coming of the depression production dropped off and did not again cross the 1,000,000,000 bbl. line until 1936 when 1,100,000,000 bbl. were taken from our reserves, which at that time were calculated to be 13,000,000,000 bbl.

In 1940 a total of 1,350,000,000 bbl. were withdrawn from reserves that were then estimated to be 18,500,000,000 bbl., and in 1943 we shall produce about 1,500,000,000 bbl. from reserves of an estimated 20,000,000,000 bbl.

Within the life of the industry, beginning in 1859, it is estimated that 28,000,000,000 bbl. of oil have been brought to the surface. About 1,075,000 wells have been drilled of which 740,000 were producing oil wells, 100,000 were producing gas wells, and 235,000 were dry holes. Some 400,000 of these original oil wells are still producing and there are doubtless a few thousand proved locations yet to be drilled.

It would appear that this 20,000,000,000 bbl. of oil in recognized reserves is sufficient to last us 13 years at our present rate of consumption, or probably 8 or 10 years with our normal rate of increase. But this is not true. It has taken 83 years to produce 28,000,-



Night view of a portion of Standard's refinery at Caripito, Venezuela

000,000 bbl. of oil and some of the earliest wells are still producing. It will without question take a more or less equal length of time to produce all the 20,000,000,000 bbl. of estimated proved reserves. Wells can only produce as rapidly as the reservoir rocks will release its fluid.

We are now producing oil at a rate approaching 4,400,000 bbl. daily, which is within 200,000 bbl. of our maximum rate of possible production without serious injury to the producing potentialities of the various fields in which wells are still flowing. It is conceivable that within a very few years subsequent to the end of the war, or even sooner, the nation will require some 6,000,000 bbl. of oil daily. Certainly after the war the nation, for its domestic consumption and normal foreign commerce, will require this quantity if it is to carry on the expansion of economy and culture that it has experienced within the last few generations and that it must continue if it is to avoid the danger of social and political chaos. With the present prospects for demands and with the reserves and production in view, we may reasonably expect to have curtailed domestic consumption or rationing for some time to come.

New Production Needed

All this indicates that new reserves and new production must be found to supply the requirements of the nation. Obviously, we would look first within our own boundaries and next, to the North American continent. It is this continent that has produced by far the greatest part of all the oil that has been brought to the surface within the history of the industry, and it is probably this continent that had the greatest reserves in the beginning, although with our lack of knowledge of the geology of Asia this may be in error. At least, however, we have produced, as already cited, some 28,000,000,000 bbl., and petroleum engineers and geologists can see an additional 20,000,000,000 bbl. in proved reserves and doubtless there are many more billions of barrels that are yet to be discovered.

The greatest potential oil bearing region of the continent remaining to be fully explored and developed is that extensive belt of country embracing the western part of the Central Continental Valley and extending from the Arctic Ocean off the Mackenzie River Basin in a southeasterly direction, including parts of the Northwest Territories, Alberta, Saskatchewan, Montana, Wyoming, the Dakotas, Colorado, New Mexico, western Nebraska, western Kansas, western Oklahoma, north and west Texas, and the Mexican states of Chihuahua, Coahuila, Nueva Leon, Tamaulipas, and northern Vera Cruz, where the Sierra Madre of Mexico meets the Gulf. This belt is limited on the west by the Rocky Mountain system and its extensions.

The geology throughout this region is by no means identical but the formations that are productive of oil are generally Permian and cretaceous, although the older Paleozoics are known to be productive and in parts offer great possibilities for reserves yet to be discovered. There are many oil fields in this 3500 mile long territory extending from the Ft. Norman field of the Mackenzie River Basin to the Poza Rica field at its southern end in the state of Vera Cruz, Mexico. It is doubtless true that there are many additional oil fields yet to be discovered by exploration and prospecting. This is the great potential oil bearing region of the continent and that to which we must look for our greatest future domestic supplies.

Other areas of potential production that are as yet unproved include the

southern coast of Alaska and the Pacific Coast of British Columbia, Washington, Oregon, and northern California. The St. Lawrence Basin likewise offers potential possibilities as does the Gulf Coastal Plain of Alabama, Georgia, and Florida. The Atlantic coastal plain including and extending northward from Florida to New York likewise offers possibilities, but the thin sediments lying above the old crystalline complex have been studied by geologists and geophysicists and many wells have been drilled in them without success. Before the oil potentialities of these several regions have been fully disclosed many more wells must be drilled on locations selected by the geologist and the geophysicist.

Even with the possibilities of new fields in the presently producing regions and many in the several non-producing regions just cited, there is no reasonable evidence that we can supply the increasing demands of the nation for any considerable length of time in the future. On the other hand, it seems probable that when the decline in production of the present 400,000 wells begins, and to these may be added the new ones that may be drilled in the meantime, we shall no longer be able to supply our requirements and it seems probable that we shall no longer be able to produce the maximum quantity that the 400,000 wells are now capable of yielding. In other words, it appears that we have now reached our peak of potential production and that within the next few months our wells will begin yielding oil at a steadily declining rate. It is possible that one or more large oil fields may be found in the immediate future that will delay the beginning of this decline, but it is hardly likely, for it would almost have to be a field of the proportions and potentialities of the East Texas field.

What of Synthetics?

When we can no longer supply our needs for lubricants and motor fuels we shall of necessity resort to synthetic fuels and lubricants derived from oil shales, coal, and vegetable matter. Lubricants from these various materials are much less efficient than are those manufactured from crude petroleum and they are likewise more expensive. These synthetic motor fuels generally have lower power potentialities and are therefore less satisfactory than are the gasolines and motor fuels of today.

It is possible that science will be able to improve these synthetic fuels, too, but certainly it will be at a cost substantially greater than for petroleum. Eventually our declining oil production will cause its products to reach a cost figure to the consumer that will permit the manufacture of synthetic fuels. Possibly at that time we shall begin to conserve our petroleum oils for the more costly and essential lubricants.

Foreign Sources of Oil

Before the industry is driven to the extremes of synthetic fuels, we shall first consume that quantity of oil that is available to us from foreign sources. The world is consuming petroleum at a present rate in excess of 2,000,000,000 bbl. annually. With the cessation of the war and the development of the various countries of the world that is anticipated, this consumption may easily reach 3,000,000,000 bbl. annually within a relatively brief period.

If we assume that the continent of South America had original petroleum reserves equal to one-half the original reserves of North America and that Asia's original reserves were equal to or greater than those of North America, it would still be necessary that the fields be developed and that the oil be transported to this country and to the other countries of the world, and it is important to remember that their consumption will most probably increase enormously. As already stated, there are 400,000 or more producing oil wells in this country out of a million that have been drilled. Eighty-three years have been required to drill this number of wells. There is no reason to believe that there will not have to be drilled a great —though hardly equal—number of wells to develop an equal amount of oil throughout the world. Much time will be required to drill them. Enormous quantities of machinery, tubular goods, and other supplies will be needed and thousands of men will have to be trained in the oil industry.

Much of this burden will fall upon Americans, for our manufacturers have had the greatest experience in the building of oil field machinery, equipment, and supplies. American oil field operators and workers have had the greatest experience in the development and operation of the industry. An enormous burden will be thrown upon us. It is inconceivable that wells can be drilled throughout the world as rapidly, cheaply, and effectively as in this country. It must be remembered that the nations in which these potential oil fields occur will require more of their own products as will the oil-less countries of the world.

When we look toward the development of the natural resources of another nation we must bear in mind that those resources are the property of a sovereign people and that they are only to be exploited and exported under those terms, under those conditions, and under those laws that are prescribed by the particular nation. These must give the nation fair remuneration in the form of just wages for its workers, a full proportion of the resource needed in its economy, and a fair exchange of other products required by its people.

It so happens that with the exception of our own country and Russia the oil producing countries of the world have not developed industrial and manufacturing economies, therefore, for the manufactured products that they require of the industrial nations they must exchange their raw or single processed products from the oil fields, the mines, and the soil. As these non-manufacturing nations develop their economy and their culture, they will need more of our products — machinery, automobiles, radios, electrical equipment of all description, and other products that require the experience and skill that these people have not yet developed. In return we shall receive petroleum and its products. We shall receive iron ore and pig iron, bauxite and aluminum, tin ore and tin, manganese ore and ferro manganese, copper, sugar and alcohol, coffee, cocoa, and the innumerable other products of the peoples of the world.

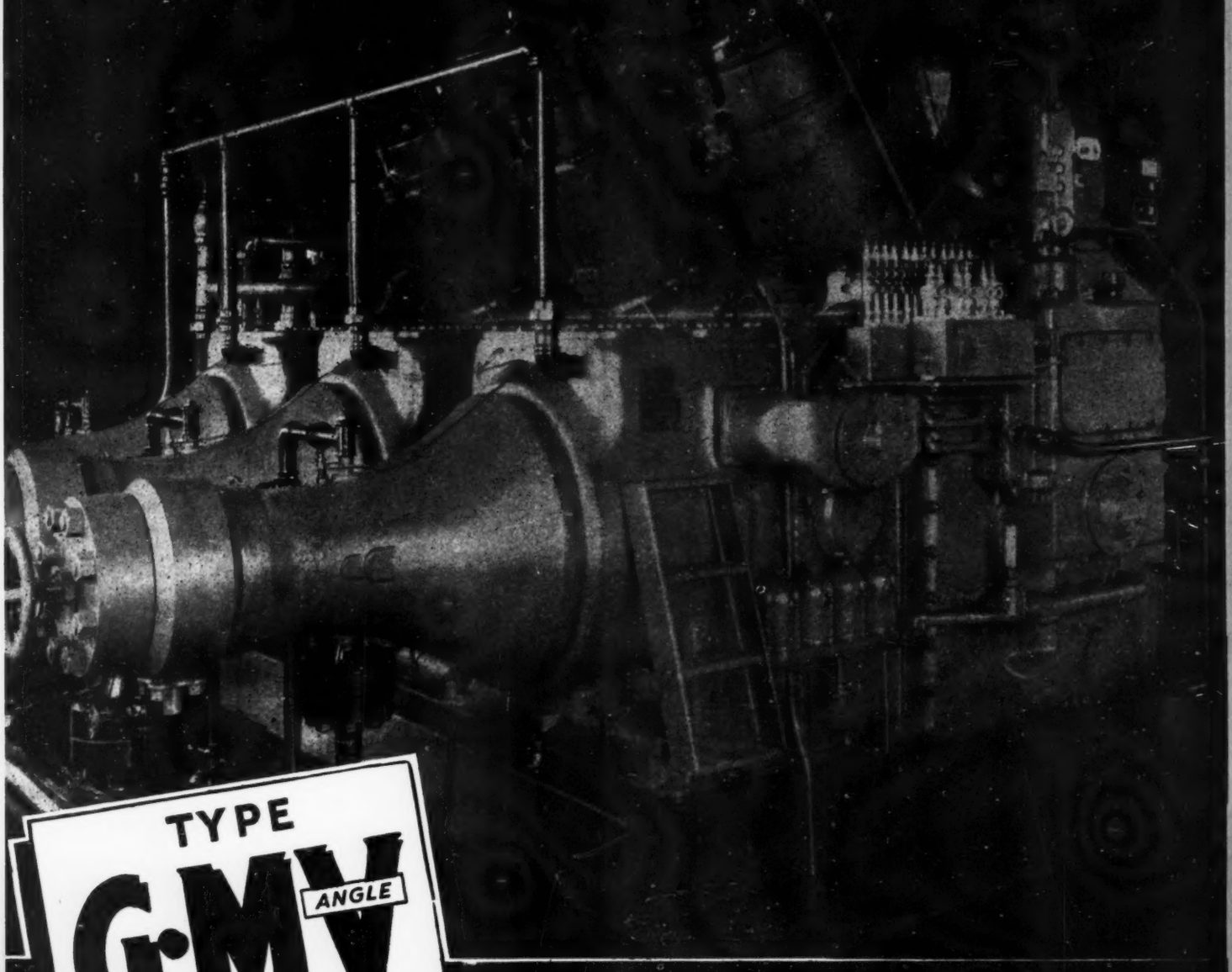
To eliminate the primary cause for wars there must be free exchange of all these products among the various nations of the world, limited only by the requirements of the various peoples, the quantities of the materials available, fair trading practices and honest products.

Petroleum is one of these materials and the nations of the world who need it have the right to receive their reasonable share of the surplus of those nations that produce oil, in fair exchange for products and commodities required by the oil producing nation, which the oil-less nations are capable of producing.

The nations of the world owe it to themselves and to their fellow nations to develop their resorces for their own benefit and for the benefit of those nations with insufficient supplies of a given resource, or they must so build their laws that other nations with their own financial, mechanical, and technical resources may undertake the development, it being always borne in mind that the host nation is the legal and moral owner of the resources to be developed and that its people have the right to expect and to receive a fair and just return for permitting the exploitation of their resources by their guests. On the other hand, the guest has the right to expect that consideration at the hands of his host that will permit him to develop the natural resource and to enjoy the fruits of his works commensurate with the efforts expended, the hazards of the undertaking, and the success attained. Laws should be made

(Continued on Page 76)

it's ready



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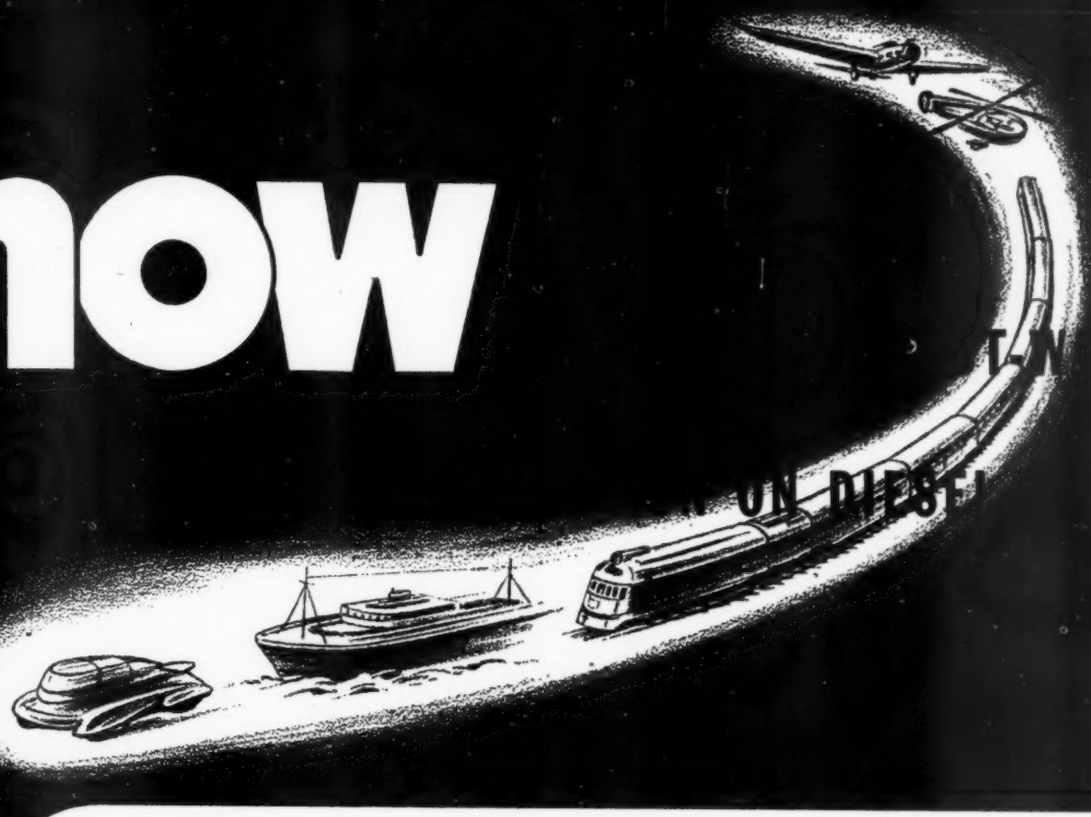

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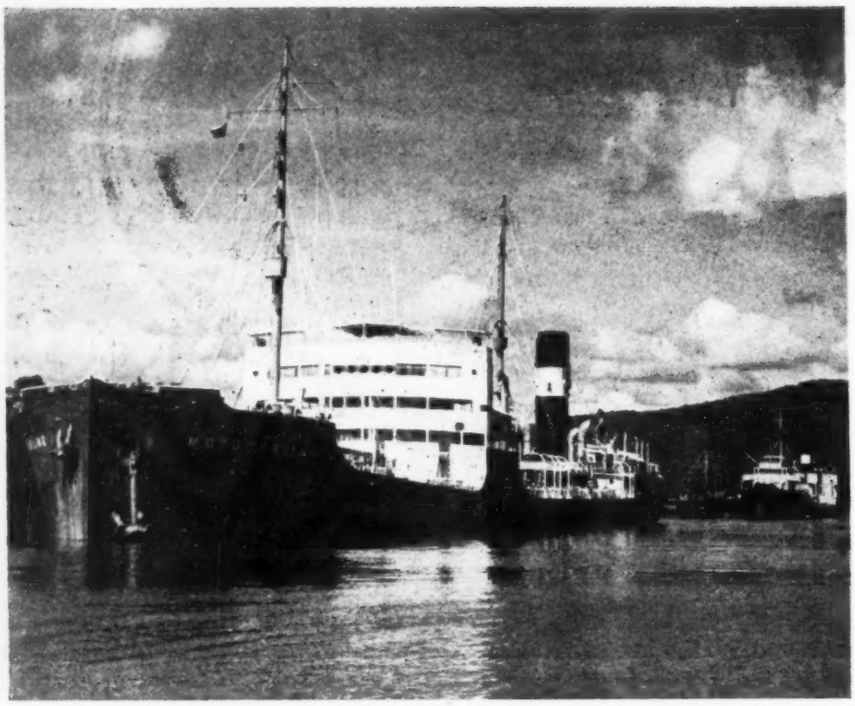


San Juan River provides a waterway to tidewater on which tankers up to 18,000 tons can navigate to Caripito, Venezuela, terminal docks
(Photo courtesy Standard Oil Company)

(Continued from Page 73)

flexible only within these very definite limitations.

Mexico

As we look outside the limits of our own country for a future supply of oil we first, and naturally, look southward, across the Rio Grande, to Mexico, Central America, and South America. The first of these was mentioned earlier as being the southern extremity of that belt of country extending from the Arctic Ocean to the Gulf of Mexico. Great oil fields have been developed in the extreme southern part of this belt such as the Panuco Field and the so-called Lower Fields to the southward of Tampico. The more recently discovered Poza Rica field is at the extreme southern end of this great monocline. Between 2,000,000,000 and 3,000,000,000 bbl. of oil have been produced from these wells. This is almost 10 percent as much as all the oil that has been produced in the United States.

Mexico at one time had prolific oil fields. Within the last ten years, which includes that part of the life of the industry during which oil finding has been most highly perfected, little exploratory work has been done and few wildcat wells have been drilled in the country. Although the possibilities of another Panuco or another Lower Fields may be limited there are many other conditions in this region under which oil might be found and the geology on the Mexican side of the Rio Grande is quite similar to the geology on the Texas side. Gulf Coastal Mexico definitely has possibilities of new and considerable oil fields.

The Isthmus of Tehuantepec and its adjoining parts of southern Mexico have likewise produced considerable oil from several oil fields. Other possibilities doubtless exist in this region. Lower California likewise offers possibilities. Mexico is a rapidly developing country and it is probable that the economic and cultural advancement will be such that its requirements for petroleum products will be substantially increased. Mexico's present production is barely sufficient to meet its own requirements and it is probable that a declining production will soon cease to suffice. First, then, new oil fields must be found and developed in Mexico to supply its own needs before we in this country can expect any considerable quantity from that source.

Central America

Central America, including Panama, has good possibilities, generally along the Caribbean seaboard, but likewise in part on the Pacific side. These countries are now importers of petroleum products and new oil must first go to supplying their own demands before they can become exporters. The areas of possible production are relatively small and we may not reasonably expect any considerable quantity of oil from these sources.

Colombia

Colombia has several fine producing fields in the upper part of the Magdalena Basin, and new discoveries have been made to the northward, nearer the coast. The entire Magdalena Basin is potential oil country as is the coastal plain, exclusive of the Santa Marta Mountain region. Colombia too is expanding its economy and culture and should increase its requirements of petroleum products in the future. It now has a surplus of petroleum to export and exchange for the manufactured products that it requires and will doubtless have more in the future. We may look to this country for modest assistance in supplying the needs of America.

Venezuela

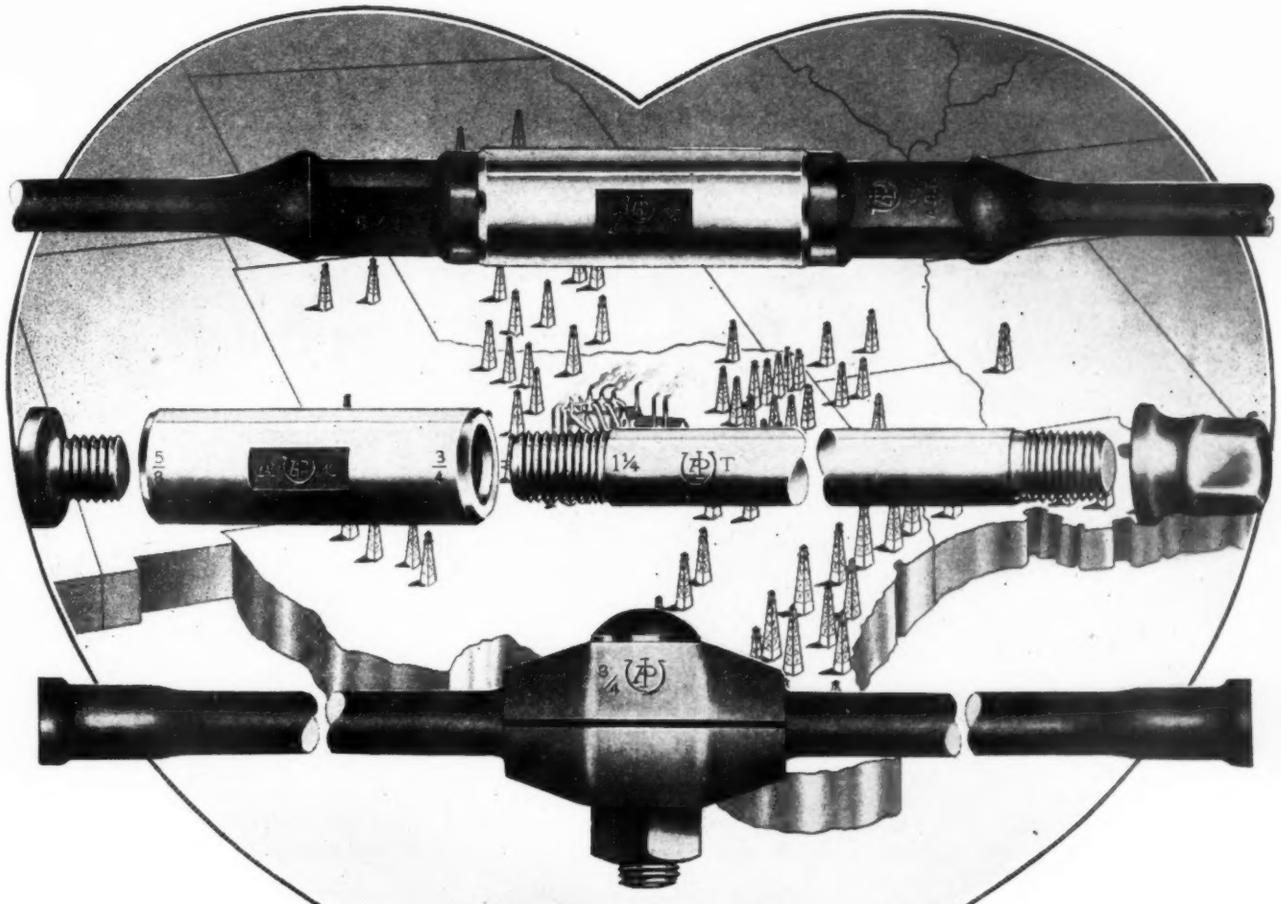
To the eastward of Colombia lies Venezuela with its great oil producing Maracaibo Basin and its probably greater Orinoco Basin. Venezuela today has a potential production of little less than 1,000,000 bbl. daily and it still has vast areas of excellent possibilities for additional oil fields. Venezuela is now and will be for some years to come one of the great oil producing countries in the world, and though in the normal development of its economy and the expansion of its culture it will require increasing quantities of its products, there will still be great quantities for export. In the past and at present most of Venezuela's crude oil has gone to Europe and other countries of South America. In the future we may expect an increasing entrance of Venezuelan oil into our own country.

Peru and Ecuador

The Pacific Coastal Plain of northern Peru and Ecuador compose a region in which oil is now being produced and where additional fields will doubtless be discovered. Products from this region have been used to supply the needs of Ecuador, Peru, Bolivia, and Chile and shipments of crude oil have gone to Argentina, Uruguay, and Brazil. Canada and Europe have likewise received large quantities. Petroleum production from the presently known reserves of this region cannot be increased. On the contrary they must decline unless and until more wells are completed in extensions of present areas of production or in new fields yet to be found. It is unlikely that this Pacific Coastal Plain will ever produce a sufficient quantity of oil to assist effectively in supplying the requirements of foreign countries other than those of western and southern South America.

South America's Potentialities

The continent of South America has



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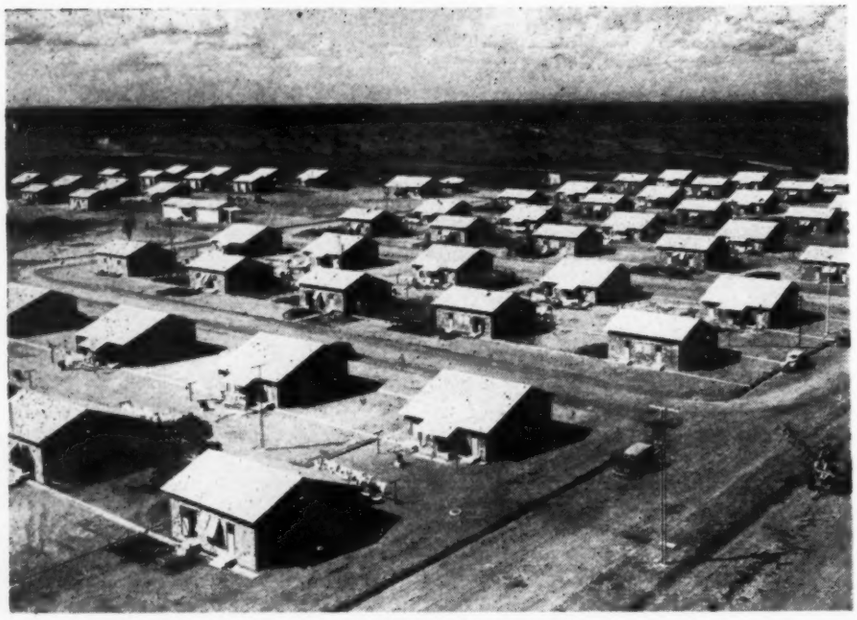

A camp for workmen, Jusepin, Venezuela
(Photo courtesy Standard Oil Company)

a great potential oil region entirely similar to that described in North America as extending from the Arctic Ocean to the Gulf of Mexico in Mexico. This vast continental syncline of South America lies between the Brazilian Landshield of the eastern part of the continent and the Andes mountain system, which extends along the Caribbean and Pacific seaboards from northern Trinidad to the tip of Tierra del Fuego. This great geosyncline is approximately 5000 miles long and varies from 50 to as much as 400 miles in width. It extends in a westerly direction from the southern end of the Island of Trinidad into Colombia, including the northern half of the Orinoco Basin, thence in a southwesterly direction through western Colombia, Ecuador, and into Peru. From here it bends southeasterly, still following in parallel the trend of the Andes into eastern Bolivia, where it assumes a southerly trend to the southern tip of the continent.

Oil fields have been found in Trinidad, eastern Venezuela, Peru, Bolivia, and Argentina. Seepages are known at scattered intervals from the northern and eastern end on the Island of Trinidad to its southern extremity near the end of the continent. Producing oil wells have been found in every part of this great region where wells have been drilled. Doubtless its potentialities are comparable to the North American geosyncline of which it is in reality the structural companion, both occupying the same continental positions relative to their adjacent mountain systems.

Argentina is unable to produce as much oil as it presently requires, but doubtless it has potentialities that, with thorough exploration and development, would easily bring it within the category of a nation having a surplus for export. With the exception of local areas, and the Andes Mountains, all Argentina is potential oil bearing country.

The great country of Brazil, with its three million square miles of territory and its almost 50 millions of peoples, is less fortunately situated from the standpoint of potential oil territory, though it has many other mineral resources in abundant quantities. For oil Brazil must look to the extreme western edge of the country in the territory of Acre, which lies within the continental geosyncline, and to the adjoining upper part of the Amazon Basin. Likewise there are potentialities in the Paraná Basin of southern Brazil and oil fields have been found in the state of Bahia near the city of Salvador and are presently producing. The potentialities of this narrow marine strip extending for several hundred kilometers along the Atlantic seaboard from Ilheos on the south to Recife on the north are excellent, but the area at best is small. It is probable that Brazil itself will require any quantity of oil that might be produced from this region.

Bolivia, in the foothills of the Andes and in the plains lying to the eastward, has excellent possibilties for large production. Its present transportation facilities are meager to non-existent, though the cost of getting oil to the Atlantic seaboard by no means would be prohibitive were its production and the quantity of its proved reserve sufficient to justify proper installations. Bolivia is a potential source of oil for its own use and for that of neighboring countries, and also, perhaps, eventually for ocean export.

Finally, there is that great, almost unexplored region of eastern Colombia, eastern Ecuador, eastern Peru, and northeastern Bolivia that is cut by innumerable large tributaries of the Amazon River system. There is only one oil field in this vast territory and it was found by the first well drilled on a fine anticline. Without having intimate knowledge of the geology of this upper Amazon region, it is reasonable to suppose that there are many more oil fields yet to be discovered.

The price of oil and the more accessible reserves of the present and past have discouraged exploration and drilling in this region, but eventually this work will be carried on. This vast country is entirely livable, healthful, and the problem of transportation to bring crude oil out and material and supplies in can be solved on the tributaries of the Amazon. The price of a barrel of oil must first be substantially higher than at present.

Summary

In summary, we have reached what appears to be the peak of our production in these United States and within the very near future, probably within a year, are destined to see our petroleum industry begin its long decline in producing capacity. In order that this decline may be kept to a minimum rate we must greatly intensify exploration for new reserves and the development of them when found. At the same time we may not within the limits of sound economy withdraw oil from new fields at such a rate that the ultimate yield will be impaired.

Discovery of new oil fields and the development of their potential resources are greatly handicapped at the present time by the low price of oil and the scarcity of material, supplies, and labor. The second of these cannot be corrected until our war effort will permit; the first can be corrected at the will of the government in such a manner that the search for and discovery of new reserves—to be developed as material and men are available—will be greatly intensified. Thereafter we must look to foreign sources to supply the deficiency of our own production. The nations south of the Rio Grande are closest to us and we know them best.

☆ ☆ ☆

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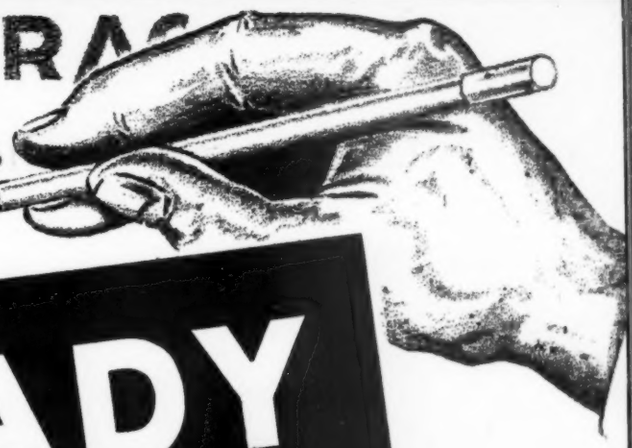

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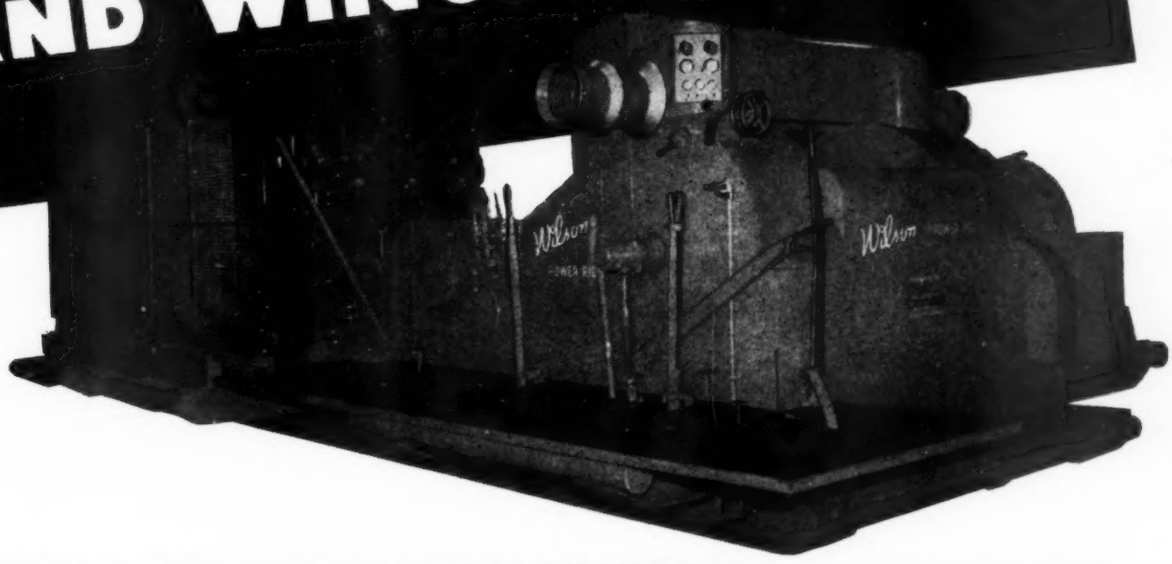

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Petroleum in Canada

☆ "Canol" project the most spectacular development of year—Turner Valley still main source of production

by Floyd K. Beach

THE most spectacular oil development in Canada this year is "Canol," about which for reasons of security there has been little reference, but some information can now be told, although many details must be left unmentioned. The Canol project is sponsored by the United States army for the purpose of delivering Canadian Oil (abbreviated to Canol) to Alaska. Begun as soon as possible after Pearl Harbor, it has now made great strides toward its objective. Colonel T. W. Essig, director of personnel for the Northwest Service Command of the U. S. Army, speaking in Calgary, last July, remarked: "The American Corps of Engineers boasts that it performs difficult tasks rapidly; the impossible takes a little longer." Two years ago most oil men who knew something of the obstacles in the path of delivering oil from Norman Wells, almost on the Arctic Circle, on the Mackenzie River, where there were only two or three small producing wells in a field of unknown size, across a barren, frozen, mountainous terrain to Alaska, would have declared the project fantastic, if not absolutely impossible. It has taken longer to accomplish than did the Alaska Military Highway, but in keeping with the traditions of the Engineer Corps, it is being done, and the end, if not yet reached, seems definitely in sight.

The project has three main parts: (1) development of enough production to supply the demand, (2) construction of a pipe line from the field to Whitehorse, and (3) erection of a refinery and means of transporting the finished product to needed points. All engineering administration and supply of this project are under direction of Brigadier General L. D. Worsham, Northwest Division, Corps of Engineers. Captain Westling, area engineer on Gen. Worsham's staff, has the first task in hand and Imperial Oil has been conducting the drilling program for him, with Dr. T. A. Link as chief geologist. This task has gone well.

The depth to production is not great, and wells are quickly completed. On completion, after a test, they are capped. Hence there are no data available from which to estimate reserves or probable production rate, but there seems to be every indication that the field will yield enough oil to meet the need in Alaska for the prosecution of war against Japan.

The second task, that of piping oil to Alaska, is a big one. When the project began the only maps of the route were on a very small scale, little better than diagrams. Some 35 years earlier a surveyor named Keele went through from the Yukon to the Mackenzie and wrote a report of the route followed, and the small scale maps presumably were based on that report. Aerial reconnaissance, however, made possible the selection of a route for the pipe line, and construction of roads were begun along which the pipe could be hauled, and laying of the welded line on the ground surface is now well under way. The problem of getting the pipe to the starting point of the line proved no small task. Navigation is open for only a short summer season, and navigation of the water route from end of steel at Waterways is no inconsiderable job. Athabaska River from McMurray to Lake Athabaska has a sandy bottom that allows the channel to wander from day to day. Shallow draft barges are needed to avoid getting aground on sand bars, and only experienced river men can tell where to steer. When the lake is reached, the shallow craft are unsuitable to weather a storm, and if transshipping is to be avoided, one must wait for quiet weather and hope to reach Slave River out of the lake before a storm hits. Fortunately the distance is not great.

About halfway down the Slave River, 16 miles of rapids from Fitzgerald to Fort Smith call for a portage. The crossing of Great Slave Lake is a much greater hazard than Lake Athabaska, for the distance in open lake is considerable, there are islands, and little to aid navigation. Once out of Great Slave Lake the worst hazards are over, but even a wide, smoothly flowing river can give trouble. At spring breakup northerly flowing rivers are subject to tremendous ice jams, for the upper reaches thaw first and let loose large freshets while the lower river is still covered with solid ice. The shortness of the open river season made it necessary to open up new roads and improve others during the winter. Chinook winds reach into this country and take off the snow

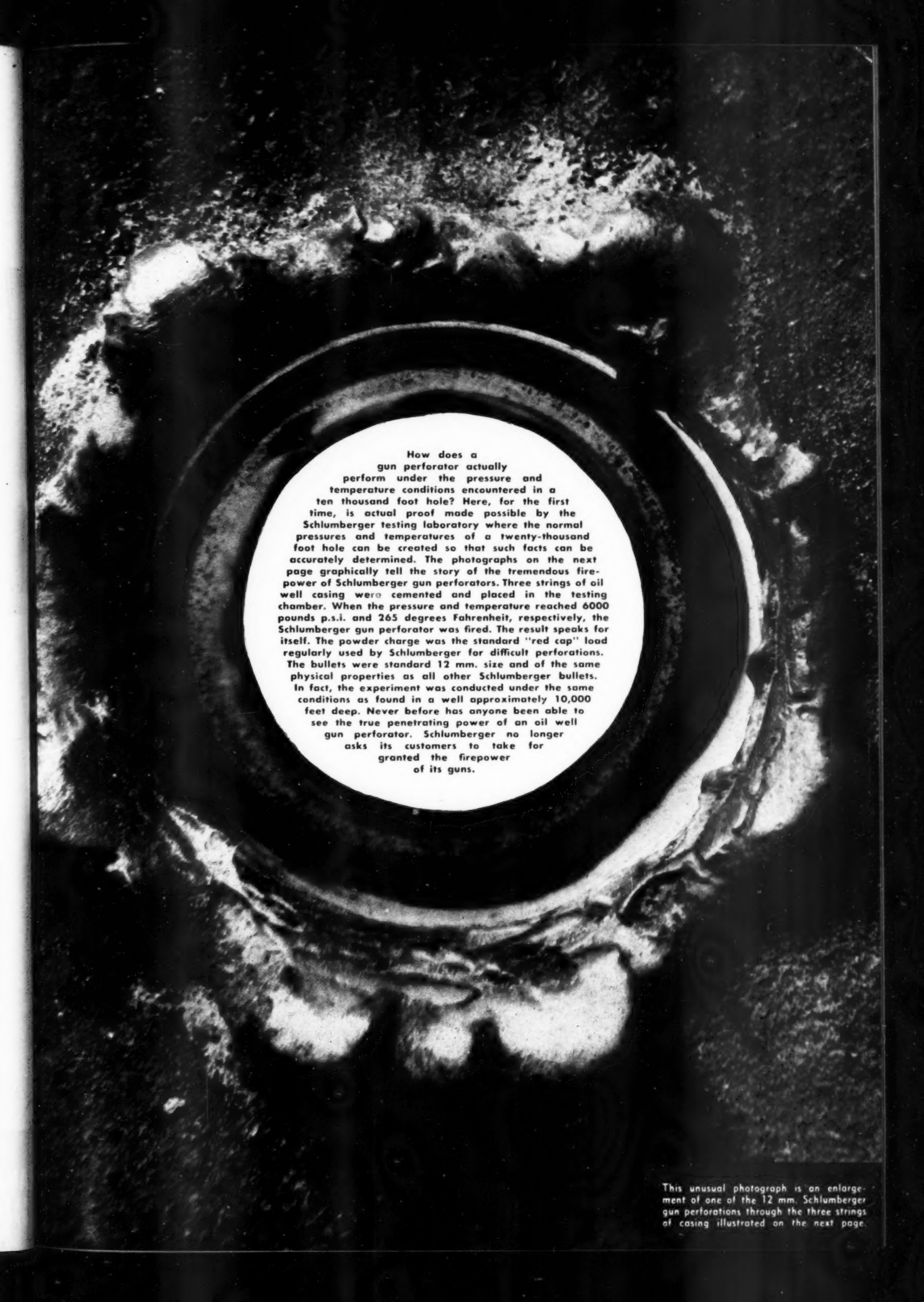
FLOYD K. BEACH

Major, Royal Canadian Engineers (Reserve of Officers), is a member of the Engineering Institute of Canada, a professional engineer (Alberta), and a Dominion land surveyor—Born and educated in Michigan, he attended high school at Traverse City and college at Albion—He went to the Canadian West in 1906 and except for three years in the Canadian Expeditionary Force in the last war has remained there—Since 1927 has served with the Dominion and Alberta governments and the Petroleum and Natural Gas Conservation Board in administration of oil and gas laws; now with the latter as engineer in charge of oil and gas production records.

counted on for making sleighs run easily, and when the Chinook ceases the temperature falls sharply. The access road was put through, however, and a tremendous tonnage of pipe and other materials was freighted in.

Characteristics of the oil are said to be such that it can be pumped at very low temperatures. Frost never goes out of the ground for more than a foot or two in summer time, so there is no object in burying the pipe. Work on the pipe line has progressed from both ends, and a refinery will be ready at the western end when the pipe is through. Oil will have to be lifted some 4000 ft. to the height of land and there is a corresponding drop westward, although Whitehorse is at a higher altitude than Norman Wells. The rise to the summit appears to be more concentrated than the westward fall.

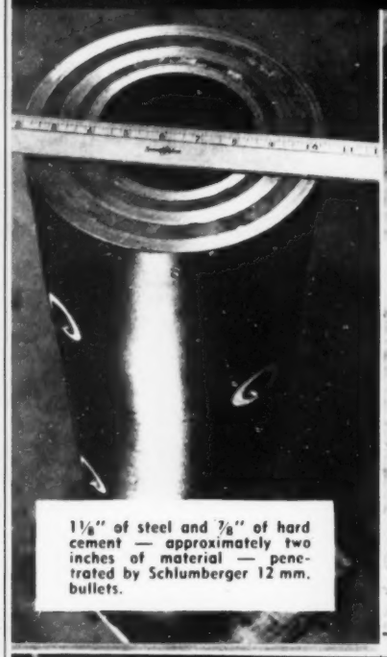
The number of personnel involved, transportation and supply problems, and climatic difficulties, all in a most sparsely settled wilderness, make Canol rank alongside the "Big Inch" as a pipe



How does a gun perforator actually perform under the pressure and temperature conditions encountered in a ten thousand foot hole? Here, for the first time, is actual proof made possible by the Schlumberger testing laboratory where the normal pressures and temperatures of a twenty-thousand foot hole can be created so that such facts can be accurately determined. The photographs on the next page graphically tell the story of the tremendous firepower of Schlumberger gun perforators. Three strings of oil well casing were cemented and placed in the testing chamber. When the pressure and temperature reached 6000 pounds p.s.i. and 265 degrees Fahrenheit, respectively, the Schlumberger gun perforator was fired. The result speaks for itself. The powder charge was the standard "red cap" load regularly used by Schlumberger for difficult perforations. The bullets were standard 12 mm. size and of the same physical properties as all other Schlumberger bullets. In fact, the experiment was conducted under the same conditions as found in a well approximately 10,000 feet deep. Never before has anyone been able to see the true penetrating power of an oil well gun perforator. Schlumberger no longer asks its customers to take for granted the firepower of its guns.

This unusual photograph is an enlargement of one of the 12 mm. Schlumberger gun perforations through the three strings of casing illustrated on the next page.

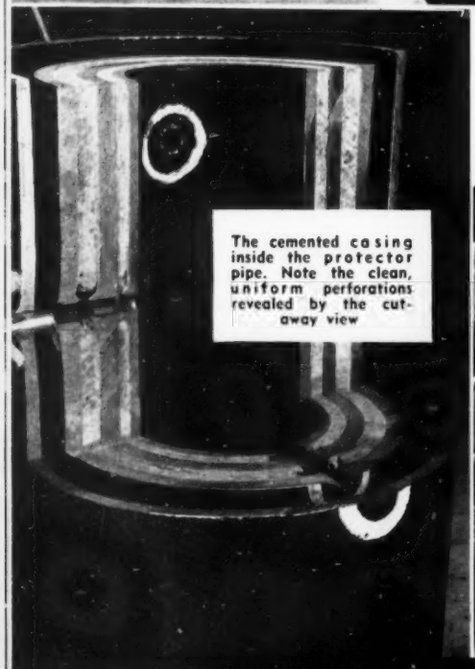
Firepower!



1⅛" of steel and ⅞" of hard cement — approximately two inches of material — penetrated by Schlumberger 12 mm. bullets.

Firepower to spare! After penetrating the three strings of cemented casing the bullets partially penetrated the 10¾" protector pipe.

Note the still sharp noses of the bullets lodged in the protector pipe at left. The cemented casing strings are at right.



The cemented casing inside the protector pipe. Note the clean, uniform perforations revealed by the cut-away view

Brinell tests of the steel penetrated. Schlumberger's armor-piercing guns get the job done!

DATA
PENETRATION TEST

GUN: Standard 100 mm.
POWDER CHARGE: 25.5 grams
(Regular "red cap" charge used for difficult perforating jobs. Normal charge—20 grams).
BULLETS: Standard 12 mm.
4 casings used for test.
3 casings cemented together.
Cement Mix—1 sack cement to 5 gallons of water.
Cement set for 68 hours.

Specifications of the Three Cemented Casings and Protector Pipe

O.D.	Thickness	Weight	Tensile Strength	Brinell	Grade
5"	7.5 mm.	15 lbs.	101,000	207	N-80
6⅝"	11 mm.	28 lbs.	97,000	196	N-80
8⅝"	10.5 mm.	36 lbs.	60,000	116	H-40
		(Protector Pipe)			
10¾"	7.5 mm.		50,000	96	

Conditions of the Test Well

LIQUID: Fresh Water
TEMPERATURE: 265° F.
PRESSURE: 6000 lbs. p.s.i.
EQUIVALENT: 10,000 ft. well (approximate)

RESULTS:

Eight shots were fired, each penetrating the three cemented casings and pointing approximately 6 mm. through the fourth (protector) casing.

NOTE: Before shooting, the gun was in water for 1 hour—the time required to raise the temperature from 212° to 265° F.

SCHLUMBERGER WELL SURVEYING CORPORATION

HOUSTON, TEXAS

(Photos by Richard Finnie for U. S. Engineers, Northwest Division)

Workmen bolt the base-sheets of an oil tank, in sub-zero weather of the Far North

These three units of a floating-plant, loaded with equipment, constitute the largest tow-load that went down the Mackenzie waterways to Norman Wells

line engineering achievement. The quantity of steel involved, and the amount of oil to be moved through the pipe line are small in comparison, but those facts do not detract from the comparative difficulties of this job, now nearing completion.

It is now more than 20 years since oil was discovered at Norman Wells. Commercial production has been obtained for more than 10 years, and since 1939 aviation gasoline has been turned out in a refinery at the wells. Operations have normally been carried on for only four months each year with a throughput of 15,000 to 20,000 bbl. per season. This output was adequate for the business formerly available. When an emergency arose demanding much greater quantities of oil delivered to a point 500 or 600 miles away, it was quite fitting for the government to go into the oil business, rather than for the project to be a matter of private initiative. Private capital would have demanded to know that there was a supply adequate to amortize the pipe line. The Army shipped the pipe first, and it appears to have been right.

Alaska Military Highway

When the Canadian Pacific Railway was built 60 years ago, it crossed hundreds of miles of country that was unfavorable for agriculture if not actually barren. Cuts made by the excavation of the road bed exposed ore in places, and the very fact that there was means of access to the Pre-Cambrian shield encouraged mining development, which has taken a foremost place in world metal mines. Now the construction of the Alaska Military Highway may be expected to enact a similar denouement of the earth's riches in an almost unknown country, much of which is probably favorable to oil development. Already we hear of a shallow well drilled about 100 ft. deep for water that gave a show of gas. Geological parties have been making studies of the terrain during the past summer.

Wartime Oils

Turner Valley continues to be the source of all but about 4 percent of Canada's oil production, and although the Conservation Board has set production allotments designed to obtain a maximum safe yield, the field seems definitely to have passed its peak. Completions in 1942, not counting dry holes, were only 28 against 43 in 1941 and fewer wells were being started. The oil controller needed all the oil he could get, and the situation resulted in a decision by the Canadian government to finance marginal wells in the proved area of Turner Valley. An announcement was made in April of this year of the formation of Wartime Oils, Ltd. A. A. Carpenter, formerly commissioner of public utilities for the province of Alberta, and at an earlier date judge of the district court, was appointed president, and directors are J. G. Spratt, general manager of Anglo Canadian Oil Company, Ltd., and associated companies; A. H. Mayland, head of Gas and Oil Refineries; L. D. M. Baxter of C. & E. Corporation, and K. J. Morrison, C. A., secretary-treasurer. C. J. Stewart is field manager. An agreement has been entered into whereby the government owned company undertakes to finance wells in approved locations, with a limit on expenditure per foot drilled.

On completion, the owners of subsurface rights will collect half of their royalty, the other half being deferred but collectible later. With this exception the net revenue will go to Wartime Oils until drilling costs and interest at 3½ percent are repaid. Wartime Oils will continue thereafter to receive a royalty of ½ percent for each $25,000 advanced for drilling, and the deferred Crown or other royalty, together with current owners royalty, will be the only charges against net revenue, the remainder accruing to the lessee.

The royalty to Wartime Oils is intended to safeguard against losses from wells that do not pay out, and it is not contemplated that the company will be a profit making venture. To date the only locations approved are in township 19, and 10 wells have actually been spudded under agreements with Wartime Oils.

Other Valley Developments

In Fig. 1, a graph of Turner Valley production from limestone wells in the "oilwell" list is given that shows the mean daily production over weekly periods from the middle of 1940 to date. Performance of a group of wells completed to the date the graph begins is also shown on the same basis and both of the graphs are at semi-log scale. From this graph it is apparent that the production has been maintained only by

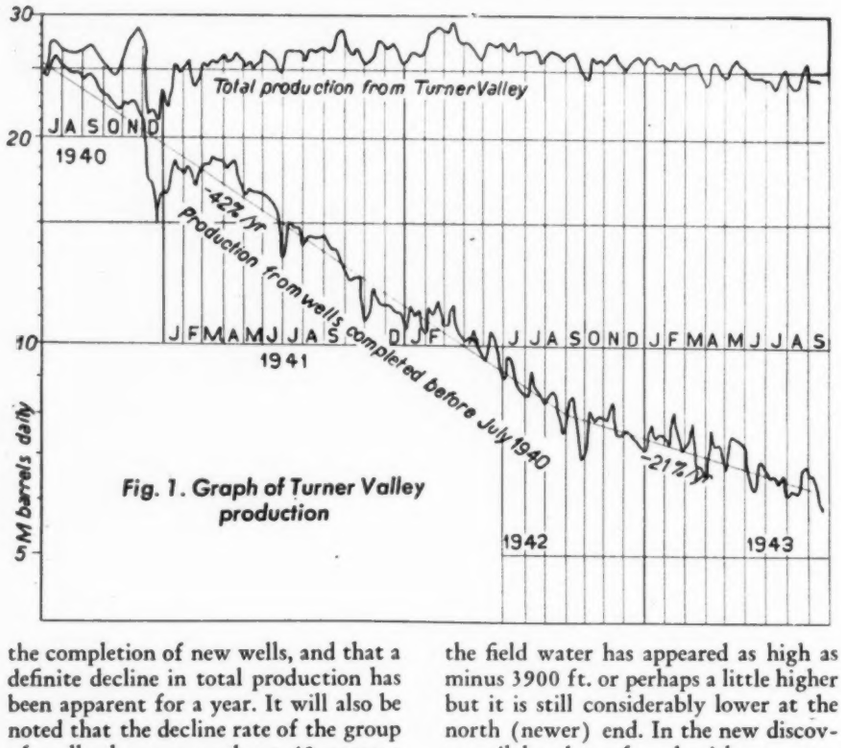

30
20
10
5 M barrels daily
Total production from Turner Valley
J A S O N D
1940
-42% /yr
Production from wells completed before July 1940
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S
1941
1942
1943
-21% /yr

Fig. 1. Graph of Turner Valley production

the completion of new wells, and that a definite decline in total production has been apparent for a year. It will also be noted that the decline rate of the group of wells shown was about 42 percent annually to the end of August, 1942. Since then the decline on the average appears to be only half as great or about 21 percent annually. This improvement may be credited to a scheme of allowable production in which the older wells, with poor gas-oil ratios, were given gas allotments. These wells may produce as much oil as they can within their gas allotment, for the most part using their own judgment regarding the manner of production. Some are produced for an hour a day, others on alternate days or at other intervals. In some cases a well has been rested for a month or more. If the combined decline rate is considered, it seems evident that the scheme has worked out for the benefit of the operators. There is no ground for believing that the oil wells in this group could produce any more oil if they were flowed full time. In a year's time they would certainly produce much less.

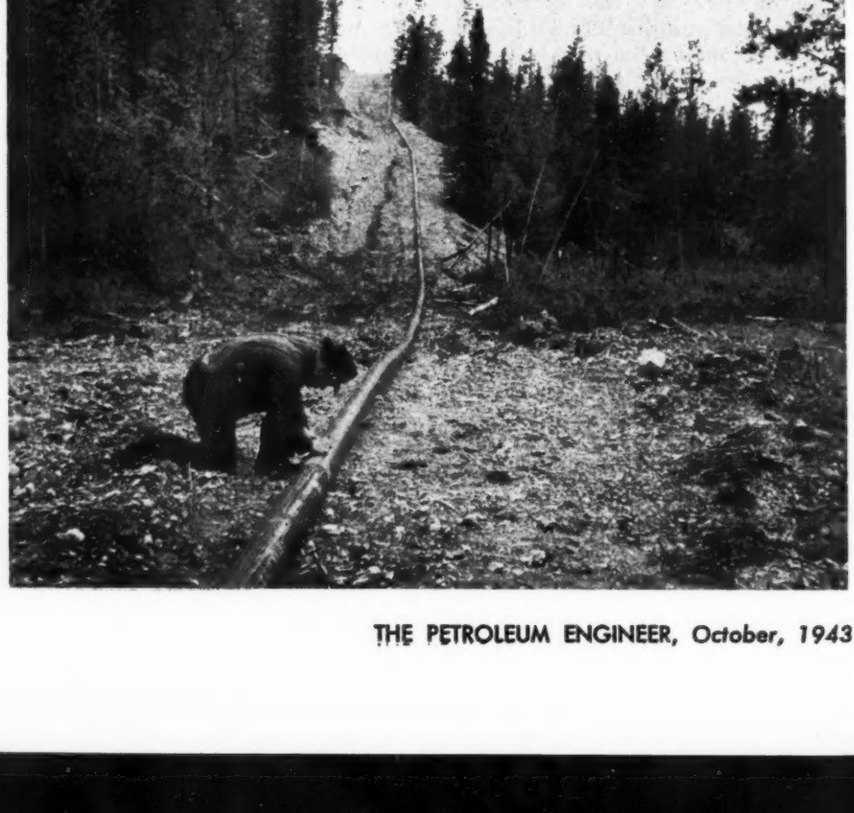
A recent outstanding discovery seems to be a second limestone occurrence below the fault block from which the rest of the field produces. It was found on the east side, at the north end of the field. The main fault block lies on a dip of 30° or more to the west with a gas cap at the top originally above about minus 2000 ft., and with oil-water interface originally about minus 4500 ft. In the southern end of the field water has appeared as high as minus 3900 ft. or perhaps a little higher but it is still considerably lower at the north (newer) end. In the new discovery oil has been found without water as low as minus 5300 ft.

During the last year the field has been extended only one location northward, British Dominion No. 5 being a much better than average well, whereas its west offset, Maryland No. 1, is only a small well. At the south end the field has also been extended one location. Brown No. 6 was begun in 1939 and drilling was suspended when it looked as though the limestone would be found too deep to contain oil. Favorable results on the location north of Brown No. 6 led to resumption this year with completion of an oil well of about average production. An offset to Brown No. 6 to the northeast, although not extending the field, is large enough to give a new interest to this part of the field.

Consideration was given to the possibility of finding a productive zone underlying the two porous zones in the Rundle (formerly called Madison) limestone. It was believed that it would be necessary to go to the Devonian limestone in order to achieve this, and a number of companies joined in a well called the Devonian Test. After drilling 1500 ft. of Palaeozoic beds the succession faulted to Blairmore and the well was completed in the Rundle as a better than average producer. The lowest stratigraphic horizon reached was lower Banff shale. In 1932 McLeod No. 4 was drilled through the Palaeozoic overthrust and encountered younger beds after penetrating more than 600 ft. of Banff shale. The Devonian test is nearly 3 miles south of McLeod No. 4 (2½ miles southerly measured along the axis of the field) and is more than 2000 ft. lower structurally at the top of Rundle limestone.

Other Alberta Developments

Vermilion. The Vermilion field had a considerable rest in production from late October, 1942, to early May, 1943. The only outlet for oil aside from a little local fuel is to the Canadian National Railway for use as locomotive fuel, and Vermilion Consolidated Oils, which was operating a plant for removal



More than 550 miles of pipe line is being laid from Norman Wells to the Whitehorse area in the Yukon
(Photo courtesy National Film Board, Canada)

Over a crystal clear Yukon lake snakes a section of the Canol pipe line
(Photo courtesy National Film Board, Canada)

of sand and water, found it uneconomic to continue operations at the 1942 price structure. Eventually a new price structure was established under which operations could continue and since May the treating plant has been in operation.

Cannar Oils, underwritten by Canadian National, has begun a development program and six of its wells were in production by the end of August with additional development in a 50-well program continuing.

The new price structure allows the producer $1.25 per bbl. for clean oil delivered at the treating plant if B. S. & W. does not exceed 25 percent and a sliding scale penalizes greater percentages of B. S. & W. From this maximum price is deducted a trucking charge of 8 cents per gross bbl. and pumping cost on an hourly basis where oil is in sumps or tanks so low as to make pumping necessary. Development in this field has not been limited to Cannar and several other companies are active.

Taber. The Taber field has seen considerable activity. The field is spotted and there have been a number of dry holes. Dominion Oil Company, a subsidiary of Standard Oil Company of California, which began operations in Alberta as Standard Oil of British Columbia, has a well in this field that produced more than 50,000 bbl. its first year. The oil is 18.5° A.P.I., free from water, and comes from the Ellis. Plains No. 2, completed in 1937, yields from the Sunburst and its 26° oil is produced with considerable water, oil forming only about 25 percent of the total liquid pumped. Dominion has drilled other wells, two of which appear to be producers and further development continues with Imperial Oil also entering the field.

Wildcats. Earlier discoveries of oil at Princess and Tilley did not prove commercial, although some oil has been produced, and prospecting near the first discoveries ceased after several wells were dry. There seems, however, to be a gas field at Princess that may prove a valuable reserve.

Most of the wildcat drilling during the year has been done by major companies, and quite a wide area has been prospected by this development. As a result of surface geological studies and geophysical work, both seismic and gravimetric, several wells on the plains explored lower Palaeozoic horizons and additional plains tests continue. A number of prospects are drilling in the foothills. One of these, Shell Norman at Jumping Pound, has recently found the top of the Rundle limestone at a depth of 11,588 ft. and has gone 171 ft. into the lime making it the deepest test in Canada. Several other tests of foothills structures are under way. Hope for another field similar to Turner Valley does not die, but wildcats in the foothills have run into considerable dry hole money, and a company must have ample resources to begin even a single test.

Most major companies of the United States are now represented in Alberta. Some of the representatives hold only a watching brief; others have gone so far as to set up a geological office, whereas several have pushed ahead to enter a drilling program.

Tar Sands

Among all the attempts at development of the Tar sands, commercial production of these important reserves of oil has not been reached, but it is very probable that they will one day become a very important source of oil in this continent. Abasand separated about 20,000 bbl. in 1941 and had a fire that seriously damaged their equipment at the end of that season. In 1942 the plant was repaired and operations began rather late with a recovery of only about 10,000 bbl. during the season. This year they had separated no oil up to the end of August but an announcement was made about the middle of April to the effect that the Dominion Government was putting up $500,000 for investigation and further development. No statements have been made during the season regarding progress but it is known that research and some field work is being done.

About 60 miles below McMurray at Bitumount, R. C. Fitzsimmons has done considerable work over a period of years and in 1938 he installed a refinery consisting of batch still, fractionating tower, and some tankage and in about 60 days operations that year separated quite a quantity of bitumen, which in part was shipped to Edmonton and has been used as a base for manufacture of asphaltic paints, roofing asphalt, etc. This year, L. R. Champion undertook to

TABLE 1
Consumption of petroleum fuels in Canada
(Condensed from Dominion Bureau of Statistics)
(Thousands of barrels)

	1942 12 months	1942 first half	1943 first half
Gasoline	26,780	11,973	11,859
Tractor distillate	1,200	532	522
Light fuel oil	8,013	4,189	4,110
Heavy fuel oil	15,892	7,768	6,699
Total	51,885	24,462	23,190

TABLE 2
Canadian crude oil production, including natural gasoline, bbl.

	1942 12 months	1942 first half	1943 first half
Turner Valley	10,003,935	5,087,637	4,803,719
Other Alberta fields	139,335	56,845	63,772
Tar sands	10,041	1,421	0
Northwest Territories	37,521	9,674	89,929
Ontario	145,090	73,865	66,737
New Brunswick	26,879	12,017	13,713
Total	10,362,801	5,241,459	5,037,870

reorganize the company under the name, Oil Sands, Ltd., and a number of men are actually working at the plant.

Very little information is available regarding results of research that has been under way for the last year or so but it is known that the oil when separated cracks easily and light products may be obtained from it as well as asphalt. What process will be used in future to make these deposits available as gasoline is still a matter of conjecture. Hydrogenation is a likely process and would probably yield gasoline at lower cost than would be the case if starting with coal. The chemical treatment of tar sands is likely to be more economical than would be the case if starting from coal and the relatively small cover over the sands permits of stripping the overburden and quarrying with power excavators as against mining coal.

Price of Oil

Effective April 1, 1943, the price of oil from the Turner Valley field was increased 15 cents per bbl., making 41° oil $1.66 with a differential of 2 cents per degree up to a maximum fo $2.12 for 64° or over; 41° is approximately the average gravity of the field. The increase in price to producers was absorbed by the refiners without increasing the retail price of gasoline.

Alberta Petroleum Association

Oil operators may watch each other's movements jealously in some ways, but in Alberta they have learned that many conditions may be improved by working together and the Alberta Petroleum Association was formed some years ago. It makes no attempt to act as a clearing house for scouting of drilling progress and geological information, functions thoroughly handled by the Petroleum and Natural Gas Conservation Board, but it does very useful work in dealing as a body with the various governmental regulations. Rationing of tires and automotive equipment are handled through the A.P.A. office, as well as applications for priorities on drilling and production equipment, labor problems involved by Selective Service and military demands, war loan drives, and many related wartime problems. B. L. Thorne is president and E. W. Kolb is full time secretary.

TABLE 3
Alberta drilling activity
(Feet of hole drilled)

1942	Turner Valley (including extension)	Other oil fields	Natural gas development	Wildcat	Total
First quarter	114,653	3,568	0	18,246	136,467
Second quarter	91,451	24,222	0	24,385	140,058
Third quarter	67,679	21,830	4,691	26,894	121,094
Fourth quarter	78,556	16,288	2,814	20,444	118,102
Year	352,339	65,908	7,505	89,969	515,721
1943					
First quarter	63,469	3,255	2,195	17,756	86,675
Second quarter	40,893	17,185	1,129	29,004	88,211

In 1942, wells drilled to exploit oil discoveries outside Turner Valley numbered 27, of which 3 produced only gas, and 8 obtained oil production. Wells listed as "wildcat" numbered 38, of which 28 were completed during the year. One obtained some commercial production, another had a good showing of oil and is still being tested, and one obtained a small showing that has not yet been produced.

During the first half of 1943, wells drilled for exploitation of oil discoveries outside Turner Valley numbered 13 of which there were 10 completions, with oil production obtained from 7. Two wells were drilled for gas development with one completion. Twenty-two wildcats drilled resulted in 2 gas wells and 9 abandonments, with 11 wells still drilling.

Equipment and Materials

Shortage of steel required for pipe and drilling equipment, refining, etc., threatened for a time to check development, but so far as can be observed, no wells for exploitation of known reserves have been halted for this reason nor can it be said that wildcat development has been stopped or even checked by reason of steel shortage. For this the Canadian oil industry must thank the sympathetic cooperation between United States and Canadian authorities. The steel shortage brought about a volume of red tape in procuring priorities and this is a burden, particularly in obtaining replacements, for a part needed in drilling may have an intrinsic value that is small in comparison with the telegraph charges required to obtain authority to purchase it, and a drilling crew at $150 per day can run up quite a bill if time is lost while the part is being obtained. Although drilling, production, and refining equipment has been available, supply of automotive equipment is now critically short.

Refining

Gas and Oil Refineries put a polymer plant into operation during the year and an alkylation plant has been erected at the Imperial Oil Refinery at Calgary. The latter has been in operation for several months. Concurrently Turner Valley natural gasoline plants have been stabilizing *iso*butane, which was formerly wasted, and there is now a proposal to combine two of the plants into one. This will involve abandonment of a low pressure absorption plant, rearrangement of present pipe lines, and some extension to gathering lines. When completed it will become possible to utilize gas now vented because of its low pressure.

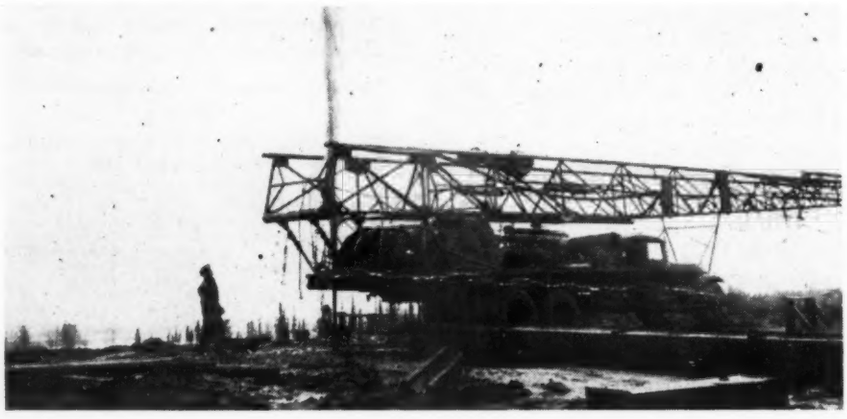
Developments Outside Alberta

In Saskatchewan several deep tests are under way but no oil discoveries have been announced. In Ontario some old wells were reconditioned and put on the pump after being inactive for several years, but most of the development has been limited to natural gas. Stripper wells yield about 400 bbl. daily. New Brunswick continues production of about 80 bbl. daily from stripper wells.

Some attention is being given to possibilities of oil development on the Atlantic seaboard with drilling in progress in Prince Edward Island and the Gaspé Peninsula of Quebec. Geological studies in Nova Scotia and other parts of Quebec may lead to drilling.

Consumption of Oil

The gasoline ration, which began April 1, 1942, on a basis of 60 coupons annually for a pleasure car and which



Another well comes in at Norman Wells

(Photo by Richard Finnie for U. S. Engineers, Northwest Division)

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Stringing pipe for the Canol pipe line
(Photo courtesy National Film Board, Canada)

permitted purchase of 5 gal. per coupon was cut to 3 gal. per coupon in the prairie provinces on October 1, 1942. In other parts of Canada the cut came earlier. Beginning also in October, 1942, many ration books were called in and a lower category was substituted. On April 1, 1943, the basic category, designated as AA, provided 40 coupons for the ensuing year. So far the value of the coupon remains at 3 gal. and the car owner may use them at his discretion, but if he runs out before the end of the year he must lay up his car. Higher categories are provided for essential driving. Pleasure driving has declined to a very low point but consumption by the armed forces has prevented any material drop in total consumption. The Alaska Military Highway demands have affected the supply for the prairie provinces.

Natural Gas

Demand for gas has noticeably risen. Many operations of the armed forces have been so situated as to permit use of gas fuel rather than coal. The coal situation has been aggravated by the diminished number of miners and at Edmonton where there is a coal field under the city and probably half the population normally uses coal for house heating, increased gas demand is found. Influx of American Army and contractor personnel to Edmonton has also increased the gas demand. Edmonton's gas supply came entirely from the Viking field from late in 1923 when gas was first delivered there until October, 1940, when gas from the Kinsella field was turned into the line. The Viking field is about 75 miles southeast from Edmonton and the Kinsella field another 10 miles beyond. Viking has 19 producing wells, at least one of which has too small a yield to be of value. Closed pressures indicate that it still has a considerable reserve of gas before compressors will be needed, but with Kinsella close by, having considerably greater reserves, it has been the policy of North Western Utilities, operating both fields as well as distribution, to conserve the Viking supply. Two Kinsella wells drilled in 1932 marked wide boundaries. Five more wells were drilled in 1941, four in 1942 (some of these were not actually completed until early 1943), and five wells were authorized for 1943. The supply of Edmonton thus appears to be well in hand for the years to come.

A recent wildcat near Athabaska found gas at a very moderate depth—about 1700 ft.—with closed in pressure of about 500 lb. and a very large open flow. Although looking for oil, the operators plan to drill more wells and should a gas field be proved it is about as close to Edmonton as Kinsella, though in a different direction.

Gas has been known to be available near Pouce Coupe for some time and a gas well was completed this year. Efforts are now being made to supply Dawson Creek, B. C., the starting point for the Alaska Military Highway, but the project is still in the prospect stage.

Calgary, Lethbridge, and other towns along the pipe line are supplied from Turner Valley. Much of Turner Valley gas reserves were allowed to go to waste, but efforts of the Conservation Board have materially reduced the wastage. Here, too, demand for gas has been increased with war activities though not as sharply as at Edmonton owing to the large proportion of the population already using gas. Quite a material load is demanded by a plant that fixes nitrogen as ammonia, a starting material for manufacture of explosives, fertilizers, etc.

When Turner Valley becomes exhausted there are not as great reserves available to Calgary and Lethbridge as in the case of Edmonton. Bow Island has some stored gas and Foremost production, useful as a standby to tide over brief emergencies, is also small. The two fields connected to the Calgary pipe line would be exhausted in a few years. Princess is the most promising other reserve within reasonable distance of Calgary and is a little more than 100 miles distant.

The Medicine Hat-Redcliff field continues to supply domestic and industrial demands within the field. Brick, tile, pottery, glass, flour milling, and green houses, are dependent on gas. One new well was drilled last year and two authorized in 1943. Pressure has gone down very materially in an area where industrial wells are too closely spaced, but the thin sand with its low permeability seems to have protected the rest of the field from too rapid depletion.

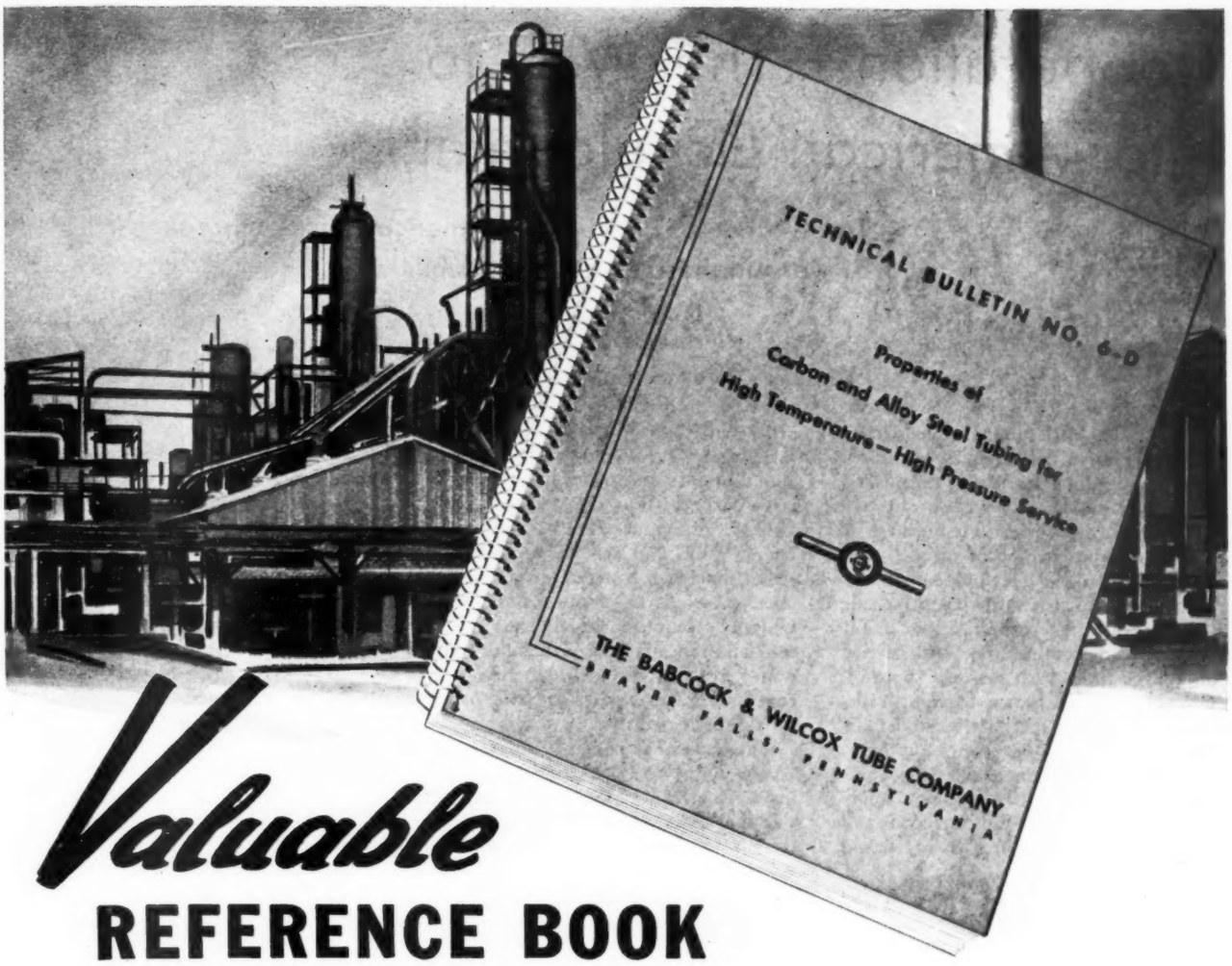
Western Canada and particularly Alberta is now looked upon in the United States as the remaining big oil prospect on the continent. Certainly its possibilities have been by no means exhausted, although wildcat wells have been scattered rather widely. One minor field was developed less than a mile from an earlier wildcat that had only a showing of oil and this leads very pointedly to the suggestion that some of the wildcat failures may have been just on the fringe of a productive area. A very active year is looked for in 1944.

☆ ☆ ☆

Rodessa Engineering Study

The U. S. Bureau of Mines has compiled and published a comprehensive engineering study on the Rodessa field in Louisiana, Texas, and Arkansas. Objective of the report is to make available factual and statistical data on well performance and to show established trends of modern operating methods and practices in high-pressure, gaseous reservoirs developed under close engineering supervision.

The field was discovered in August, 1930, when a well drilled to a depth of 5506 ft., in Caddo Parish, Louisiana, produced gas in commercial quantities. Discovery of oil was in July, 1935, at a depth of 6048 ft. Consisting of approximately 24,500 acres of oil-bearing land developed by 1,026 wells and 18,500 acres of gas-bearing land developed by 116 wells, the field was estimated to have produced 127,153,228 bbl. of oil to January 1, 1942, or 72.2 percent of its anticipated 176,000,000 bbl. of recoverable oil.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Cooperation—The Way to Inter-American Development

PETROLEUM ENGINEER Exclusive Feature

☆ Trade progress between the Americas since outbreak of war emphasizes future possibilities

by John C. McClintock
Assistant Coordinator of Inter-American Affairs

WHEN Hitler launched his armies against Poland in September, 1939, and plunged Europe into war, there was immediately widespread recognition in the Western Hemisphere of the need for expansion of inter-American trade, and the development of new industries in Latin America. Like the United States, the other American republics from colonial days had carried on a large trade with Europe. In 1937, a year of fairly heavy foreign trade, about 30 percent of all the exports of Latin America went to continental Europe. In turn, continental Europe supplied about one-third of Latin America's imports, mainly factory goods and industrial materials such as steel and chemicals.

As the ruthless Axis war machine swept over continental Europe, into the Mediterranean and Russia, the forces operating to draw the Americas closer together for hemisphere defense and trade became more compelling. This was particularly noticeable after the fall of France in 1940 and the attack on Pearl Harbor. Our armament program, swelling into gigantic and unprecedented war production after Pearl Harbor, opened a tremendous market for metals and other raw materials from hemisphere sources.

With the fall of Singapore and the Japanese conquest of the great tropical resources of the South Pacific, inter-American trade received further stimulus. This is the stimulus derived from the development of new and additional hemisphere sources of rubber, quinine, fibers, and vegetable oils to replace the loss of supply sources in the Far East. These products of tropical agriculture and forests before the overrunning of Malaya, the Philippines, and the Netherlands Indies by the Japanese had been imported chiefly from the Orient, although rubber and cinchona trees are native to the tropical Americas.

Trade Increases

Together, these forces were sufficient to roll up a huge volume of trade between the United States and the other Americas. In fact, imports from the other Americas in 1941 and 1942 totaled about $1,000,000,000 each year, about double the pre-war volume. In large part, this was the result of heavy United States purchases of metals, nitrates, wool, and other essential materials from Latin America. In dollar volume, these increased purchases by the United States offset largely the elimination of most of the continental European market from Latin America's foreign trade. Our exports to Latin America also increased sharply.

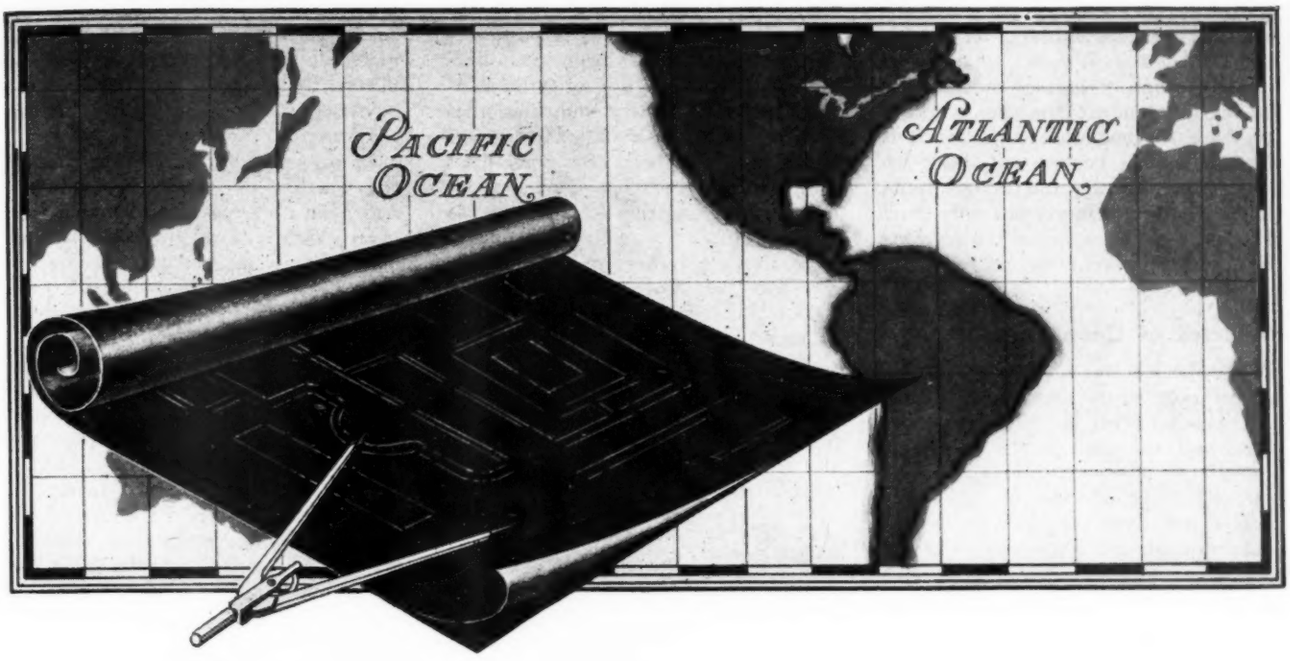
There were important limitations, however, on the war-time growth of inter-American trade. First came the shipping shortage, in evidence as a limiting trade factor before Pearl Harbor as well as afterward. Then came the wholesale conversion to war work of manufacturing industries that ordinarily provided the bulk of United States exports to Latin America, such items as automobiles and industrial machinery. Also largely absorbed into war production were steel, chemicals, and other factory materials that the other Americas in the earlier phases of the war had purchased in larger quantity from the United States to replace former imports from Hitler-dominated continental Europe.

Through most of 1942 and well into 1943, the major limiting influence on trade between the United States and the other American republics was shipping. More recently, however, improvement in shipping conditions has been reflected in relatively heavy imports of such items as coffee and cocoa from Latin America and an increase in Caribbean oil production. At the height of the shipping squeeze, great peace-time staples of inter-American trade like coffee, cocoa, and sugar had to give way to copper and manganese and similar strategic war industry needs in competition for shipping space.

Meanwhile, supply rather than shipping has become more important as the determinant in the volume of exports from the United States to Latin America. Inventories and stockpiles of manufactured goods, from automobiles to hair pins, have declined. Steel, chemicals, electrical equipment, and other basic industrial supplies have been channeled largely into war production. It is impossible to make a close analysis of these trends in the absence of detailed foreign trade figures, discontinued by the Commerce Department for security reasons; but there are various indications of an increase in imports from Latin America as contrasted with the export trend. In the first six months of 1943, for instance, balance of trade statistics show the other Americas exported to the United States $208,000,000 more than they imported from this country, excluding gold and silver. This represents a further rise in the balance in favor of the other Americas over the 1942 level, when Latin America accumulated the heaviest export surplus in trade with the United States in 20 years. Another indication of the trend is the Commerce Department's August figures on total United States imports. These amounted to $316,000,000 against $186,000,000 in August, 1942.

Besides such items as coffee and cocoa, the recent rise in imports undoubtedly includes strategic metals and rubber, quinine, and other tropical-grown materials formerly imported mainly from outside the Western Hemisphere. The war-time development of Hemisphere resources is yielding an increasing volume of these strategic products. Although the total production still is small compared with former imports from outside the hemisphere, the trend is upward for imports of these items from Latin America.

What is the significance of these trends? This question can be answered accurately only when the trends can be studied in a long perspective of time and postwar testing of inter-American trade foundations. But one thing is obvious: the development of inter-American trade since the outbreak of the war in Europe more than four years ago emphasizes the potentials that exist in the vast and varied resources of the Americas. These potentials, as we have seen, can be developed and realized in terms of complementary production and interchange among the Americas.



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Another important point about the wartime development of inter-American trade is this: it shows what can be done through voluntary cooperation among independent countries, working together for common ends. For it is inter-American cooperation, built up the last half century and brought to its highest peak of achievement since Pearl Harbor, that has expedited the development of hemisphere resources and inter-American trade.

Vehicles of Cooperation

The mechanisms for inter-American cooperation in the economic field, as well as other fields, have been strengthened and enlarged. Inter-American committees and commissions and new agencies of the individual American republics have been organized to provide improved means for cooperation in the development of hemisphere trade and industries. These include the Inter-American Financial and Economic Advisory Committee, the Inter-American Development Commission and the development commissions in each of the 21 republics, and the Inter-American Coffee Board. In Costa Rica, the Inter-American Institute of Agricultural Sciences has been established to improve hemisphere agriculture and aid in the development of complementary production and trade. The United States, through the Office of Inter-American Affairs, has set up special agencies for cooperation in health and sanitation, food growing, and transportation projects to support development of hemisphere resources. These are matched by many similar agencies set up by other American republics. When this war is over, the machinery of inter-American coöperation will be much more highly organized than before the war.

The new vehicles of inter-American cooperation have been established within the framework of inter-American cooperation evolved from a series of Pan American Conferences and meetings of American Foreign Ministers. At the Rio de Janeiro Conference of American Foreign Ministers, held shortly after the attack on Pearl Harbor, the basis was laid for a great program to mobilize hemisphere resources behind war industry and to bolster hemisphere defenses. Under this program many bilateral arrangements have been made between the United States and other American republics for development of production of strategic materials, for improvement of health and sanitation conditions, for building strategic highways, for extension of credits, and sharing of machinery and technical skill to develop basic industries essential to hemisphere defense and strategic production.

Thus development of hemisphere resources has gone forward on a broad scale, despite the slowing or postponement of industrial development in lines that do not rate high priority on shipping space, machinery, industrial materials, and technical skill. Hemisphere development, in short, now generally is in a pattern of war necessity, and this development contributes greatly to United Nations war strength in supplying increasing amounts of indispensable materials for North American and British war industries. The importance of these contributions to United Nations productive strength can only be set forth clearly when trade figures reveal the variety and the volume of metals, oil, fibers, rubber, foodstuffs, and other exports of Latin America to the United Nations.

Productive Power Demonstrated

The immense productive power of the Americas is being demonstrated on a scale few foresaw before the war. Raw materials from the mines, farms, and forests of Latin America join with the factory capacity, technical skill, the capital of North America to make possible the tremendous volume of war production. Here the Americas have a remarkable revelation of what can be accomplished in way of production when the countries of this hemisphere work in close unison toward a common objective.

Nor have we seen the end of this demonstration, for the Rio development program is still in progress, and the full measure of the fruits of this hemisphere development have yet to be measured.

A sure road to fuller development of hemisphere resources has been marked out, however—the way of inter-American cooperation. This principle is being tested in the greatest world struggle in history. The inter-American system of cooperation, with its achievements in war production, stands out in the fateful events of these years in vivid contrast with the brutal Axis way of aggression and oppression. The slave labor of Europe driven by fear of Hitler's hangmen cannot match the productive work through voluntary collaboration of the Western Hemisphere countries.

One lesson already presents a challenge to the Americas. This is the lesson of what can be accomplished on the hemisphere front through cooperative effort. Out of wartime development of hemisphere resources come many practical benefits that will be just as useful after the war as during the war. These include airports, highways, hospitals, and training schools. They include strategic projects like Brazil's new steel plant at Volta Redonda and the rehabilitation of key Mexican railroad lines, undertaken with United States aid to speed the movement of strategic materials to North American war industry. Out of such wartime developments come long-enduring benefits for the American peoples.

Moreover, if history repeats, part of the wartime development of inter-American trade and production will remain after the world's trade routes and markets are re-opened for freer movement of international commerce. Out of the First World War expansion of inter-American trade came a net gain when world trade was restored to more normal patterns in the postwar decade period. No one can say at this stage just what alterations in world trade will result from the present conflict. But Europe, along with North America, is a natural market for Latin America's coffee, cocoa, and other tropical products. In addition, Europe has been the main market for South America's grain, meat, and other products which North America produces abundantly. It is logical to assume that, in the reopening of the continental European market to world trade, Latin America's exports, too, will return in large measure into old channels. Nevertheless, the base for inter-American trade is being broadened through the development of new industries, the improvement of hemisphere transportation, the increase in Latin America's purchasing power, and through closer inter-American cooperation. The development of Latin America's industries and production of basic materials and foodstuffs in the past has been accompanied by expansion in the Latin American market for the products of United States industries. This long-range trend has been accelerated since the beginning of the war in 1939.

In summary, the achievements of wartime development of hemisphere resources afford a demonstration of the practical results to be gained through the collaboration of free nations. Inter-American cooperation, in these years of bitter world conflict, has pointed a way toward peaceful, friendly relations among nations operating within a framework of collaboration for common interests. At the same time, inter-American cooperation points a way to fuller development of hemisphere resources for the raising of American living standards over the long run. The opportunity to apply this lesson to peacetime tasks of increasing hemisphere production for civilian needs will arise after the war. The machinery for inter-American cooperation exists, enlarged and tested in wartime. Whether these mechanisms of inter-American cooperation can be used as successfully in peacetime as in war remains to be seen.

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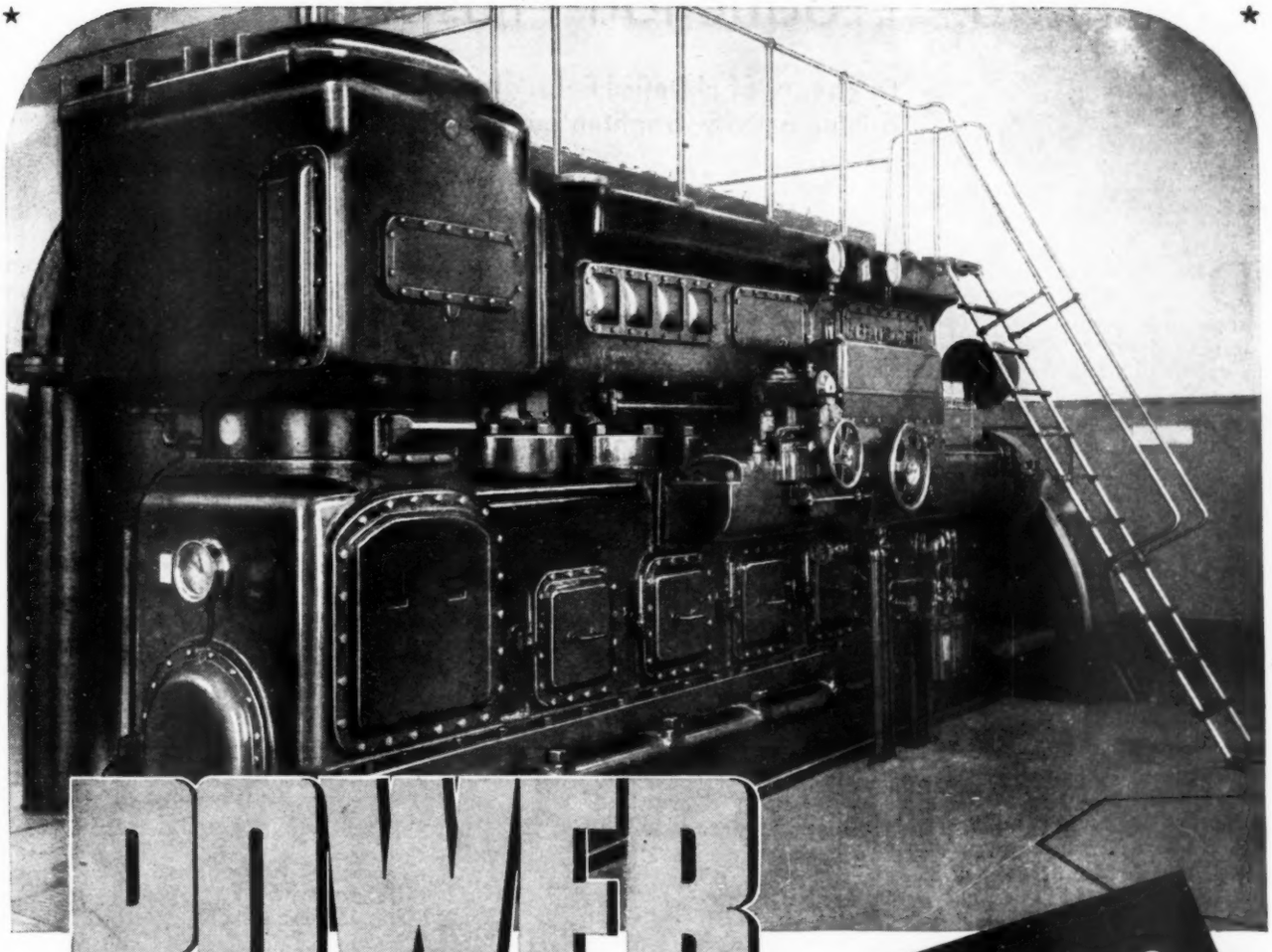

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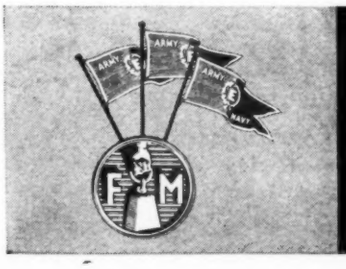

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Colombia's Production Prospects

PETROLEUM ENGINEER Exclusive Feature

☆ **Discovery of El Deficil field, other drilling activity, brighten outlook**

by Wallace A. Sawdon

Pacific Coast and Foreign Editor

DISCOVERY of the El Deficil field in northern Colombia, has increased that country's producing areas to eight. Access to tidewater, however, is still confined to the two long pipe lines transporting oil from the DeMares concession of Tropical Oil Company and the Barco concession of the Colombian Petroleum Company. Tropical's Infantas and La Ciras fields near Barranca Bermeja and Colombian's Petroles field near the Venezuelan border are thus producing virtually all the oil for export.

The latest discovery at El Deficil by Compania Petroleo Shell de Colombia lies in the Magdalena Valley but is on a plateau approximately 500 ft. above sea level where the climate is good in comparison to that in most of the Magdalena Valley. The structure is approximately 70 miles from tidewater and is about halfway between El Banco on the Magdalena River and Santa Marta on the Caribbean Sea.

The first well, El Deficil No. 1, was drilled high on the structure and turned out to be a gas well. The second well was located lower on the structure and came in as a high pressure flowing well producing 34° A.P.I. gravity oil from a limestone formation. The producing zones are between 6200 and 7200 ft. and the productive formations are very thick. No water problems have yet been encountered but it was necessary to maintain the mud weight at 105 lb. per cu. ft.

Three strings of rotary tools are operating in this general area on exploratory work. The company is considering operation of several additional strings and will probably place them in the middle and lower Magdalena Valley areas. The discovery at El Deficil makes the lower valley prospects more promising. The Richmond Petroleum Company is drilling an exploration test in this area. This company is also drilling in the middle Magdalena Valley northwest of Puerto Wilches.

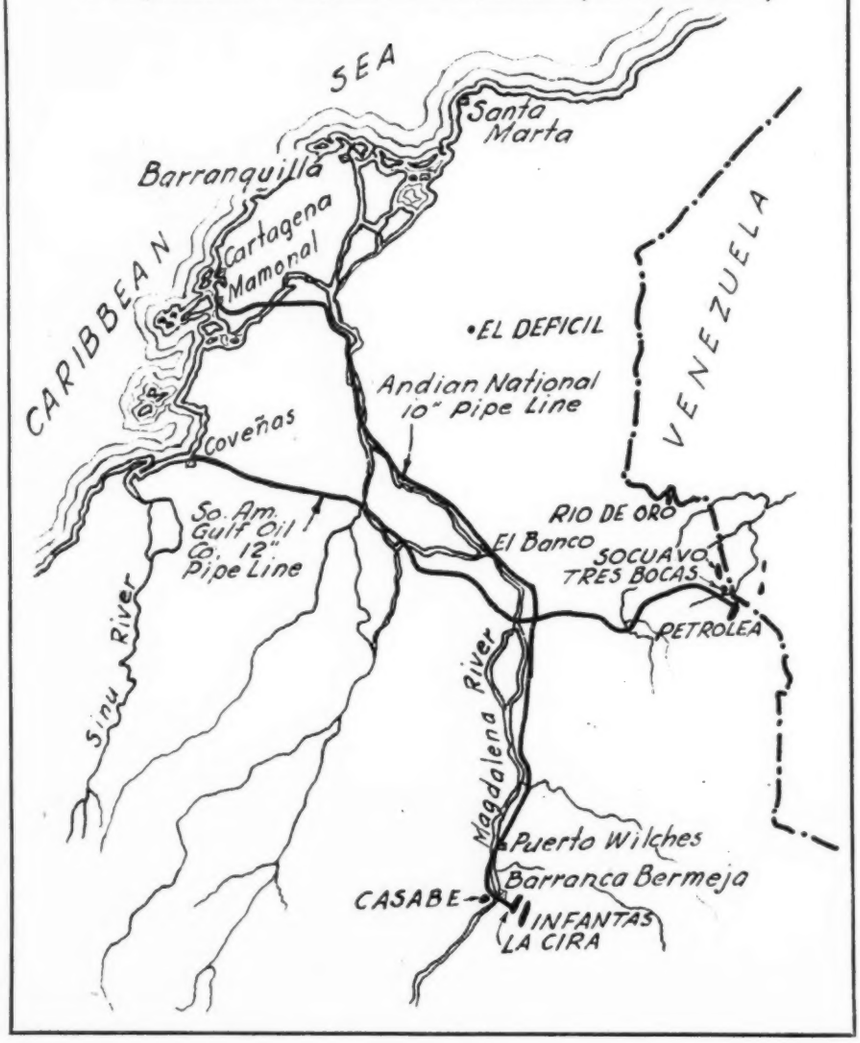
In the Casabe field across the river from Barranca Bermeja the Shell de Colombia has drilled 10 producers. The depths range from 4000 to 5000 ft. and the gravity of the oil averages 24° A.P.I. Three rotary rigs are active in this area, two being on exploratory work. The company is perfecting its camp and protecting operations from flood waters of the Magdalena River, as the elevation is very low. No pipe line connects this field to tidewater and no plans for pipe line construction have been announced. There is a possibility that when a pipe line is built to carry the Casabe production to tidewater it will be laid to provide junction with the El Deficil field. The oils from these two fields, however, are of different gravity.

Colombian Petroleum Company's operations in the Barco have been hampered greatly by lack of equipment and supplies. In addition to the Petrolea and Rio de Oro fields, this company now has production at Tres Bocas and Socuavo. Wells at Tres Bocas range in depth from 8500 to 9000 ft. At Socuavo a good flowing well was brought in at 4500 ft. Both fields produce a black oil from 31° to 34° A.P.I. A great many new well locations have been staked out and these will be drilled as soon as equipment becomes available. Drilling would begin at once if the equipment were available.

Socony-Vacuum Oil Company of Colombia drilled a well near Puerto Wilches and got a small producer. This is reported as being on the Casabe structure. Another rig is said to be drilling in this area. With an agreement with the Tropical Oil Company, Socony-Vacuum is to drill a test for Troco about 40 miles up the Sinu River from the coast. This operation is a costly and difficult project because of the terrain and the inaccessibility of the location.

☆ ☆ ☆

All oil production of Colombia is in the northern part of the country



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An Investigation of U.S.S.R. Crude Oils[1]

☆ The properties of gasolines and the content of non-hydrocarbon components of crude oils of different geologic ages

by G. D. Gal'pern (Halpern) and I. A. Musaev

Institute of Mined Fuels of the Academy of Science, U.S.S.R.
Laboratory of Petroleum Chemistry

CRUDE oils are complicated systems consisting of various types of hydrocarbons and resins with more or less admixtures of organic bases, phenols, acids, asphaltenes, and carbenes. The chemical investigations of crude oils carried out so far in Russia and published in the literature refer mainly to crude oils having no definite geologic characteristics. In other words, the oils were considered to constitute merely complex reservoir mixtures of crude oil derived from various sands and oil wells.

The commercial and chemical classification adopted in the U.S.S.R. either is very complicated, as for example, the commercial-production classification of crude oils proposed by A. M. Plotko, or too schematic, as for example, the chemical classification adopted by the Grozny Petroleum Research Institute. The proposed classifications have nothing to do with the genesis of crude oils, whereas the composition of the various commercially valuable ingredients of crude oils of different chemical compositions is the result of complex natural historical conditions of the formations of this most interesting caustobiolyte.

The necessity for a different basis for classifying crude oils is emphasized more and more as the industry develops, especially as the need for investigating fundamental reasons why crude oils in different deposits are not the same assumes major importance in problems involving the geological-chemical mapping of oil-bearing areas. Life itself dictates the necessity for constructing a geological-chemical-genetic classification of crude oils. In that connection, if available experimental information is considered, it is quickly found that such a classification cannot be made without first organizing planned and complex investigations by chemists and geologists including microbiologists, paleogeographists, and paleontologists.

It is the writer's hope that the work being carried out in the Laboratory of the Genesis of Crude Oil and Petroleum Deposits of the Institute of Mined Fuels will help in attaining a solution of the problem, which has as its aim a systematic investigation of the composition of Russian crude oils.

The first problem encountered by the investigator of crude oils is the question, what is crude oil? Is crude oil a definite system formed according to some law by which the composition of individual components determines the composition and nature of all or the majority of the remaining components? Does this system contain individual series that are more or less independent of each other?

A positive answer to these questions is found in the original practical classification of crude oils that has been accepted for many years in the U.S.S.R. and in America. In classifying crude oils into three classes, i.e., crude oils with a paraffin base, crude oils with an asphaltic base, and crude oils with a mixed base, it is admitted tacitly that the composition of solid paraffins and resins, which are independent of each other, may characterize at least the basic properties of the entire crude oil and the possibilities of deriving gasoline and lubricating oil from them.

This classification, however, was found to be unsatisfactory with increasing knowledge of the nature of crude oils that has accumulated simultaneously with the qualitative and quantitative growth of the oil industry. In America the classification of asphalt-base crude oils has been replaced by oils with a naphthene base, and intermediate classes are introduced. In so doing, the nature of the light and heavy fractions of the hydrocarbon components of the crude oil is determined from the properties of comparatively narrow boiling-point fractions (one boiling at 250-275°C. and distilled at atmospheric

TABLE I
Geological (age) characteristics of crude oils

Location of deposit	No. of oil wells	Age of oil-bearing sands
Pirsagat (Alyaty)	27	Pliocene, producing sands, Second Pirsagat deposit (sands)
Neftedag	....	Pliocene, red colored (analog of producing sands) sands
Surakhany	....	Pliocene, producing sands (Kirmaki sands?) sands
Lok-Batan	189	Pliocene, producing sands, lower section, Layer VIII (sands)
New Grozny area	....	Miocene, chokras-spirialissic horizon (sands)
Old Grozny area	2-29	Miocene, chokras-spirialissic horizon, Layer XVI (sands)
Shor-Su	1	Oligocene, horizon "P" (limestones)
Maikop	171	Oligocene, Maikop layer (horizon of light crude oil, Layer C_2 (sands with heaving clays)
Krasnokamsk	7	Carbon, Mart'yan layer (C'_2) Horizon A (organogenetic broken sandstone with thin layers of black clay)
Syzran	10(?)	Carbon, Turnei layer (C_1) (black clay and sands)

[1]Translated from the Russian oil journal *Zhurnal Prikladnoi Khimii*, (Journal Applied Chemistry U.S.S.R.) 12, No. 4, 1939, pp. 563-571, by A. A. Boehtlingk, Berkeley, California.

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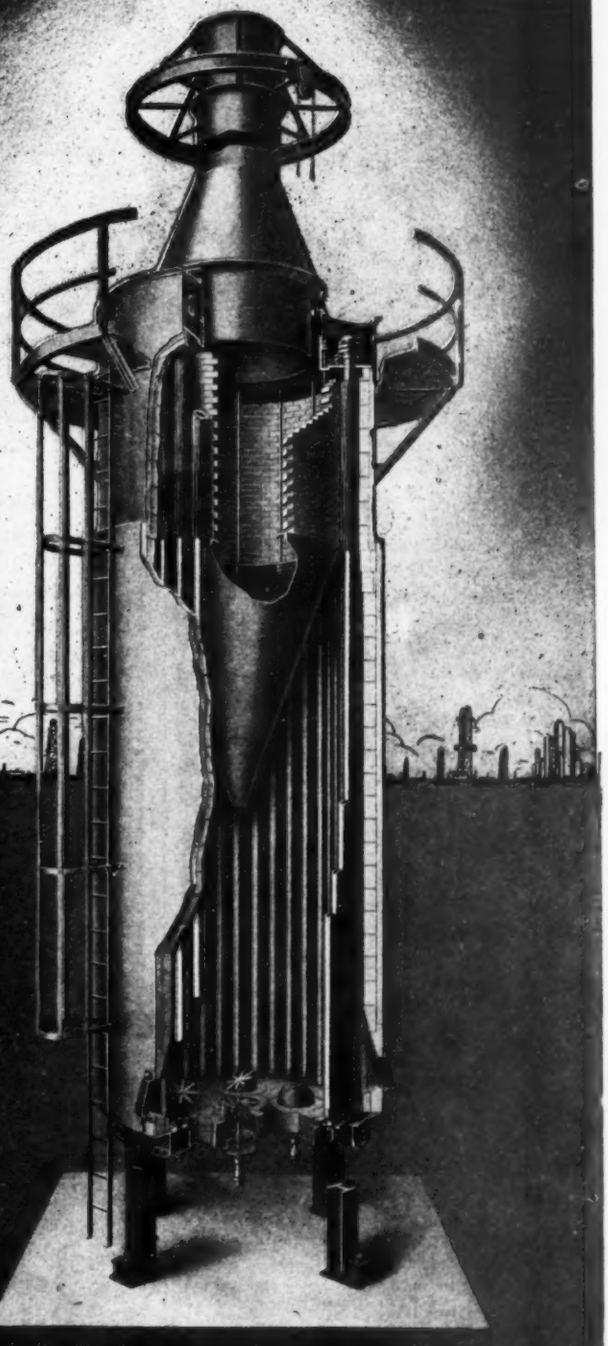

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pressure, and one boiling at 275-300°C. at a residual pressure of 40 mm.). This new practical classification thus recognizes that the hydrocarbons of the majority of crude oils and those that are the final products of the refined crude oil, constitute for each individual crude oil a regular system sufficiently characterized by two basic boiling points.

The chemical classification of crude oils proposed by the Grozny Petroleum Research Institute, and the one that has found wide application, considered in its original modification, is a classification of crude oils according to their total content of representative hydrocarbons of various series in the entire crude oil. To do this unquestionably was a step backward so far as the American classification is concerned and it is all the more surprising that it was done because the total composition of crude oil is determined in the U.S.S.R. with much greater accuracy and for a greater number of fractions than in America. A classification of crude oils based upon their total content of representative hydrocarbons of various series shows immediately that the chemical nature of the light and the heavy fractions is different, which also is true for the transition from the first to the second fractions. These differences are discussed in detail in the second edition of the "Chemistry of Petroleum" by S. S. Nametkin in which the latest chemical classification of crude oil is given.

The common criticism of the new classification is its complete disregard for the non-hydrocarbon type of components. These components, however, are characteristic satelites of all crude oils and assume great importance in the genetic classification of crude oils; likewise they are of major importance in problems connected with the production and refining of crude oils. Therefore, it is natural that the practical refiners and others consider the contents of resins and solid paraffins as essential characteristics of crude oils.

In the work discussed here the aim is to attract again the attention of petroleum chemists to the relationship between the properties of the non-hydrocarbon components of crude oils and the characteristics of the hydrocarbon system that is the base of the latter classification of crude oils.

Experimental Work

Samples of ten different crude oils were investigated by K. E. Zinchenko in the Laboratory of Petroleum Sands of the Institute of Mined Fuels of the Academy of Science for their polar properties. The data obtained are used in part as the basis for the following discussion.

The general geological characteristics of the crude oils are given in Table 1.

To obtain a general idea of the light hydrocarbon part of the crude oils, 500 ml. of each was distilled in a 40 centimeter Widmer-Dobryanskii tower.[2] The volume yields for every 5°C. cut were recorded as were the yields by weight of fractions boiling below 60, at 60-95, 95-120, 150-175, 175-200, 200-225, and 225-250°C. The investigation of the chemical nature of the last fraction still is being continued.

The resulting data are summarized in Tables 2, 3, and 4. Refractive indices are presented in Table 5 to give a better general idea of the chemical nature of the light fractions. Table 5 also gives the specific gravities of the crude oils as determined in 100 cc. picnometers.

The Syzran and Shor-Su crude oils were received in the laboratory as emulsions and they were heated for two weeks with solid calcium chloride in a reflux condenser over a boiling water bath. At the end of two weeks the oil was allowed to settle and was then distilled. The samples contained a noticeable amount of hydrogen sulphide and other sulphur compounds, which on being distilled yielded some elementary sulphur. The quantity of sulphur compounds has, as yet, not been determined.

Table 6 presents data showing the percentage of solid paraffins and that of a number of non-hydrocarbon compounds in the crude oils under investigation.

Free bases were extracted from 100 grams of crude oil by two washings with 20 ml. of a 10 percent solution of sulphuric acid. The acid extract was neutralized with a 10 percent solution of sodium hydroxide and the separated bases were extracted with ether. The ether extract was dried, the ether distilled off from a weighed flask, and the second weighing of the flask immediately gave the content of bases in percent of the crude oil. Additional bases, which are present in the petroleum acids in the form of salts, are freed after the separation of acids and phenols. These "combined bases" were extracted in the same manner as the free bases. It is evident that in so doing only such bases are extracted that form water-soluble sulphates.

[2] G. D. Gal'pern, Izvestiya Akademii Nauk U.S.S.R. Seriya Khimicheskaya, 1937, 959.

TABLE 2

Yields of 5°C. fractions in percent by volume. (Obtained by fractionating 500 ml. of crude oil in a 40 cm. column of the Widmer-Dobryanskii type)

Boiling point of fraction, °C.	Crude oil									
	Pirsagat Alyaty	Neftedag	Surakhany	Lok-Batan	New Grozny	Old Grozny	Shor-Su	Maikop	Krasnokamsk	Syzran
Below 40	....	....	....	....	0.72	1.16	....	1.72	....	....
40- 45	*	....	....	....	0.12	0.12	....	0.40	0.92	....
45- 50	*	*	....	*	0.12	0.24	*	0.30	0.20	*
50- 55	*	*	....	*	0.16	0.24	*	0.56	0.20	*
55- 60	0.2	1.16	....	0.1	0.44	0.38	0.06	0.66	0.40	0.20
60- 65	0.48	....	....	0.16	0.60	0.48	0.04	0.84	1.02	0.08
65- 70	0.24	....	....	....	0.32	0.56	0.06	0.72	0.24	0.12
70- 75	0.18	....	†	65-80	0.40	0.60	0.06	0.48	0.22	0.04
75- 80	0.20	60-85	†	0.16	0.48	1.08	0.12	1.12	0.26	0 14
80- 85	0.26	1.48	0.12	0.08	0.60	1.08	0.10	1.06	0.44	0.40
85- 90	0.34	0.76	0.20	0.10	0.64	0.90	0.48	1.30	0.84	0.14
90- 95	0.96	0.84	0.76	0.24	0.80	1.14	0.30	1.48	1.42	0.28
95-100	0.32	1.12	0.28	0.36	1.16	1.48	0.28	1.92	1.16	0.22
100-105	0.56	0.60	0.30	0.28	0.82	1.08	0.06	1.48	0.92	0.32
105-110	0.56	0.30	0.34	0.36	0.88	0.90	0.34	1.40	0.72	0.50
110-115	0.28	0.92	0.48	0.56	0.72	0.94	0.08	1.80	1.12	0.18
115-120	1.04	0.56	0.60	0.48	0.84	0.40	0.12	1.20	0.66	0.26
120-125	0.48	0.54	0.68	0.52	0.84	0.76	0.24	1.50	0.76	0.62
125-130	0.68	1.00	0.56	0.38	0.90	1.40	0.30	1.30	1.40	0.76
130-135	0.54	0.54	0.64	0.48	1.08	1.52	0.56	1.26	1.14	0.18
135-140	0.62	0.52	0.60	0.50	1.08	1.32	0.92	1.48	1.28	0.26
140-145	1.22	0.92	0.98	0.32	0.70	1.38	0.54	1.60	1.20	0.54
145-150	0.70	0.52	0.82	0.40	0.96	1.42	0.72	1.88	1.18	0.58
150-155	0.46	0.68	0.88	0.56	0.96	1.02	0.76	1.00	1.30	1.06
155-160	0.86	1.04	0.98	1.08	0.76	0.98	0.62	1.20	1.64	0.28
160-165	1.16	0.66	0.84	1.08	0.76	0.96	0.74	1.78	0.32	0.26
165-170	0.28	1.62	1.00	0.72	0.76	0.86	0.70	0.96	0.46	0.62
170-175	0.48	0.34	1.48	0.76	1.16	0.66	1.06	1.26	0.80	0.86
175-180	1.40	0.48	0.36	0.52	0.92	1.20	0.84	0.74	1.64	0.38
180-185	0.52	0.66	0.56	1.14	0.96	1.48	0.54	1.58	2.38	0.34
185-190	0.96	0.72	0.84	0.82	0.76	1.24	0.40	1.56	0.32	0.44
190-195	0.70	0.94	0.50	0.58	0.72	0.66	0.58	1.26	0.36	0.80
195-200	0.90	0.40	0.48	0.60	0.78	0.82	0.80	0.80	0.81	1.60
200-205	1.08	0.72	0.72	0.58	1.08	0.96	0.80	1.20	0.80	0.58
205-210	1.20	0.90	1.04	1.00	1.22	0.84	1.06	1.30	1.16	0.48
210-215	0.88	0.76	0.78	0.66	0.50	0.76	1.12	0.88	0.68	0.52
215-220	1.04	1.22	1.38	0.96	0.60	0.80	1.18	0.88	1.44	0.84
220-225	1.44	1.30	0.60	1.40	1.24	1.18	0.28	1.30	1.36	2.56
225-230	1.36	1.00	1.32	1.60	0.96	1.12	0.82	1.04	1.04	0.46
230-235	1.36	0.78	0.60	1.68	1.04	0.12	0.44	0.78	0.96	0.58
235-240	1.20	1.04	1.36	1.20	1.16	0.84	0.66	1.46	1.76	0.56
240-245	1.28	1.12	0.94	0.92	1.56	0.78	1.42	0.88	0.60	0.80
245-250	2.04	1.42	1.14	1.80	1.20	1.66	2.00	1.48	1.16	1.52
Residue.....	71.9	68.4	70.0	73.0	63.6	58.1	76.0	48.0	61.0	76.8
Losses.....	1.5	2.0	1.1	1.9	2.0	1 6	1.8	2.0	0.3	1.8

*Below 60°C. †Below 85°C.

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Strong acids (carboxylic acids) were extracted by means of two treatments with 20 ml. of a 3 percent solution of sodium bicarbonate. The bicarbonate solutions were neutralized after the extraction (using congo as an indicator) with a 10 percent sulphuric acid and the separated acids were extracted and determined in the same manner as was described for bases. In a similar manner, by treatment with a 5 percent solution of sodium hydroxide, phenols and weak acids were separated out of all the oils except Old Grozny and Neftedag crude oils. Old Grozny and Neftedag crude oils yielded such a strong coloration of the caustic extract that in a second extraction (complete extraction) a 10 percent solution of caustic and in a third extraction a 5 percent solution was used. The last extraction was almost colorless. In the case of bases it should be mentioned that only such phenols and acids were extracted as are capable of forming water-soluble sodium salts and phenolates.

The content of resins, asphaltenes, carbenes, and solid paraffins was determined in crude oils free of acids, phenols and bases after washing to a neutral reaction. Because aqueous solutions in a number of cases produced stable emulsions with crude oil, a few milliliters of ether were added to break up the emulsions, and to some of them sodium sulphate was added. Ether and the light gasoline fractions were distilled off on a water bath before carrying out further determinations. One-fifth, by volume, which corresponded to 20 g. of the original crude oil, was taken from the residues and diluted with 400 ml. of light petroleum ether. Asphaltenes and carbenes separated from samples left standing overnight (except in the case of the Surakhany crude oil, which did not yield a precipitate). The asphaltenes together with the carbenes and the filter were placed in the thimble of the small Zuntz extractor (hot Soxhlet) after the filtration, where oil and solid paraffin were washed off with petroleum ether; benzene was used for the extraction of asphaltenes, and carbenes were finally extracted with chloroform. The thimble remained absolutely clean as the result of the last operation.

The percentage of asphaltenes and carbenes in the crude oil is determined after distilling off benzene and chloroform from the tared flasks, followed by a second weighing and multiplying the results by 5. The determination of "silica-gel resins" was carried out simultaneously with the determination of asphaltenes and carbenes. For this purpose, one-tenth of each of the "phenol" and gasoline free residues was mixed with silica-gel until the formation of a brownish and absolutely friable mass was observed, which then was placed in the thimble of the Zuntz extractor. Oils and paraffins were removed in the extractor with petroleum ether, and the total asphaltenes, carbenes, and silica-gel resins were extracted with chloroform. The chloroform then was distilled off, the product weighed, and the results multiplied by 10 to give the percentage of total asphaltenes, carbenes, and resins in the original crude oil. The content of silica-gel resins in the crude oil was obtained by subtracting the percentage of asphaltenes and carbenes found previously.

The filtrate of petroleum ether from the precipitated asphaltenes and carbenes, together with the corresponding extract, were evaporated on a water bath, the light fractions were distilled off in vacuo (10 mm. residual pressure) and the temperature of the escaping vapors then was raised rapidly but carefully to +110°C. by heating with an open flame. The residues from the vacuum distillation were diluted with 75 ml. of a mixture of benzene and acetone (the mixture contained 3 parts of benzene and 2 parts of acetone). The resulting solutions were kept for about one hour at a temperature of minus 28 to minus 30°C. (using denatured alcohol and solid carbon dioxide) and the precipitated paraffins then were filtered off at the same temperature. The paraffins were washed with a pure (cooled) benzene-acetone mixture and placed, together with the filters, in weighing beakers. The remaining solvents were removed by heating in the drying oven to 110°C. The difference between the weight of the beaker with the filter and the paraffin and the original weight gave, when multiplied by 5, the percentage of solid paraffins in the crude oil.

As may be noted from the aforesaid, a slight change was made in the accepted analytical procedure. The essence of the change that was introduced consisted in the substitution of the consecutive analysis of asphaltenes and carbenes, resins and paraffins by a parallel determination. This procedure shortened the analytical procedure considerably without noticeably affecting its accuracy. As the paraffin determination was made without preliminary removal of the resins, a solvent consisting of a mixture of benzene and acetone had to be used instead of the customary Holde mixture, i.e., a mixture of ether and alcohol. The mixture of benzene and acetone has become quite popular lately in the commercial dewaxing of oils. It is a much better solvent for resins and possibly also for polycylic

TABLE 3

Volume percent of light fractions of crude oil distilled over every 5°C.

Percent off to °C.	Crude oil									
	Pirsagat Alyaty	Neftedag	Surakhany	Lok-Batan	New Grozny	Old Grozny	Shor-Su	Maikop	Krasnokamsk	Syzran
40	....	....	....	....	0.72	1.16	....	1.72	....	....
45	....	....	....	....	0.84	1 28	....	2.12	0.92	....
50	....	....	....	....	0 96	1.52	....	2.42	1.12	....
55	....	....	....	....	1.12	1.76	....	2 96	1.32	....
60	0.2	1.16	....	0.1	1.56	2.14	0 06	3 64	1.72	0 20
65	0 48	....	....	0.16	2 16	2 62	0.10	4.48	2.74	0.28
70	0 72	....	....	....	2 48	3 18	0.16	5.20	2 98	0.40
75	0.90	....	....	....	2.88	3.78	0 22	5 68	3.20	0.44
80	1.10	....	....	0 32	3 36	4 86	0.34	6.80	3.46	0.58
85	1.36	2.64	0.12	0.40	3.96	5.94	0.44	7.86	3.90	0 98
90	1 70	3.40	0 32	0 60	4.60	6 84	0.92	9.16	4.74	1.12
95	2.66	4 24	1.08	0 84	5.40	7.98	1.22	10.64	6 16	1.40
100	2.98	5 36	1 36	1.20	6 56	9.46	1 50	12.56	7.32	1.62
105	3.54	5.98	1.66	1.48	7 38	10.54	1.56	14 04	8.24	1.94
110	4.10	6.26	2 00	1 84	8.26	11.44	1.90	15 44	8.96	2.44
115	4 38	7 18	2 48	2.40	8.98	12 38	1.98	17.24	10 08	2 62
120	5 42	7 74	3 08	2 88	9.82	12 78	2 10	18 44	10 74	2.88
125	6 00	8 28	3 76	3.40	10 66	13 54	2 34	19 94	11.50	3 50
130	6.68	9 28	4.32	3.78	11.56	14 94	2 64	21.24	12.90	4 26
135	7 22	9.82	4 96	4 26	12 64	16 46	3 20	22 50	14 04	4.44
140	7.84	10 34	5 56	4.75	13 72	17 78	4 12	23 98	15 32	4.70
145	9.06	11 26	6.54	5 06	14 42	19.16	4 66	25 58	16.52	5 24
150	9.76	11 78	7.36	5 48	15 38	20 58	5.38	27 46	17.70	5.62
155	10.22	12 46	8.24	6 04	16 24	21 60	6 14	28.46	19 00	6.68
160	11.08	13 50	9 20	7.12	17.00	22 58	6.76	29.66	20 64	6.96
165	12 24	14 16	10.04	8 20	17 76	23 54	7.50	31.44	20 96	7.22
170	12 52	15 78	11 04	8 92	18 52	24.40	8.20	32 40	21.42	7.84
175	13 00	16.12	12 52	9.68	19 68	25 06	9 26	33.86	22 22	8.70
180	14 40	16 60	12.88	10 20	20 60	25 26	10 10	34.60	23.86	9 08
185	14 92	17.26	13.44	11.34	21.56	27 74	10.64	35 18	26 24	9.42
190	15 76	17 98	14.40	12 16	22 32	28 98	11 04	36.74	26 56	9.86
195	16 26	18.92	15.10	12.74	23 04	29.64	11 62	38.00	26 92	10.66
200	16 74	19.32	16.00	13 34	23 82	30 46	12 42	38.80	27 73	12 26
205	17 46	20 04	17 08	13.92	24 90	31.42	13 22	40.00	28.53	12.84
210	18.50	20 94	18 28	14 92	26.12	32.26	14.28	41 30	29.69	13.52
215	19.28	21 70	19.16	15 58	26 62	33.02	15 40	42.18	30.37	14.04
220	20.66	22.92	20 20	16.54	27.22	33.82	16 58	43.06	31 81	14.88
225	21 26	24.22	21 64	17.94	28 44	35.00	16.86	44 36	33.17	17 44
230	22 58	25 22	23 00	19 54	29 40	36 12	17.68	45.40	34.21	17.90
235	23.18	26 00	24.36	21.22	30 44	37 04	18 12	46 18	35 17	18.48
240	24 54	27 04	25 56	22 42	31.60	37 88	18 78	47 64	36 93	19.04
245	25 48	28.16	26 84	23 34	33 16	38 66	20 20	48 52	37.53	19 84
250	26.62	29.58	28.88	25.14	34.36	40.32	22.20	50 00	38.69	21.36
Distillate plus residue.....	98.52	97 98	98.88	98.14	97.96	98.42	98.20	98.00	99.69	98.16
Losses.....	1.48	2.02	1.12	1.86	2.04	1.58	1.80	2.00	0.31	1.84

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hydrocarbons. The mixture that was used consisted of 3 volumes of benzene and 2 volumes of acetone. Both reagents were of the chemically pure variety and were used directly as received without any further treatment. The proposed ratio of the components (3 to 2) and the weighed amount of crude oil (20 g. per 75 ml. of the solvent) was found to give the best results. An increase in the proportion of acetone lowers markedly the solubility of most crude oils, and an increase in the proportion of benzene requires lowering the temperature of separation. The latter, of course, can be done easily but it causes the benzene to crystallize and thus automatically lower its concentration in the solution. All the weighing was done with the idea of simplifying the calculations as much as possible.

Results

The number of crude oils investigated does not permit drawing a final conclusion common to all crude oils. It may be pointed out, however, that for the crude oils that were investigated, a relation between the content of bases, strong acids, and the properties of the light fractions could be noted. This is particularly true for the crude oils having about the same geologic age. The increase in the content of bases is related to an increase in the content of carboxylic acids and to an increase in the refractive indices of almost all fractions boiling below 250°C. Because of the extremely small amounts of bases and acids present in the samples under investigation and as they are present in still smaller quantities in the samples of gasoline, the increase in the refractive indices of the gasoline is unquestionably the result of the enrichment of the fractions by carbon. In other words, there is either an increase in the content of aromatic or of naphthene hydrocarbons in the fractions. Further investigations will show which of these two possibilities actually takes place.

In general, the content of phenols in all the oils changed in the same direction. Quite outstanding are the Old Grozny and the Neftedag crude oils where the content of phenols is about 40 times higher than the average content of phenols in all the other samples. The nature of these phenols and the cause for their accumulation in these crude oils must be specially investigated.

The content of solid paraffins, silicagel resins, asphaltenes, and carbenes do not show such an obvious relation to the properties of the gasoline-naphtha fractions and the content of bases, acids, and phenols in the crude oils. If it seems possible to note certain regularities in the composition of crude oils of the same age then the comparison of crude oils of different ages so far does not permit making any general statements.

In summarizing, the conclusion arrived at is that probably three basic groups of substances, independently of each other, were the original substances from which crude oil was formed, and that only one of them is related to gasolines. The first group yields as the result of geochemical conversion, light and possibly heavy hydrocarbons, bases, acids, and to some extent phenols. The second group yields petroleum resins and it may be related to the formation of heavy and polycylic hydrocarbons. The third group yields solid paraffins and higher paraffin hydrocarbons.

Conclusion

The genetic classification of crude oils is the classification of the future. It will throw some light on the relation between the components of crude oils, their history, sources, and conversions during geologic time.

Accumulation of experimental data that will help in the creation of such a classification is the thesis of the current investigation of four Pliocenic (Pirsagat, Neftedag, Surakhany, and Lok-Batan) crude oils, two Miocenic (Old Grozny and New Grozny) crude oils, two Oligocenic (Shor-Su and Maikop) crude oils, and two carbonaceous (Krasnokamsk and Syzran) crude oils. The relation between the properties of gasoline-naphtha fractions and the contents of basic and acidic components in crude oils is discussed in this report. No relation was found to exist between the content of solid paraffins and asphaltic resinous substances for which there is no regularity in their mutual ratios or in the properties of the gasoline and naphtha fractions.

☆ ☆ ☆

TABLE 4

Yields of fractions (percentage by weight) in the fractionation of 500 ml. of crude oil in a Widmer-Dobryanskii column.

Crude oil	I. B. P. °C.	Fractionation temperatures, °C.								Residue	Loss
		Below 60°C.	60-95	95-120	120-150	150-175	175-200	200-225	225-250		
Pirsagat (Alyaty)	16	....	2.05	2.16	3.69	2.86	3.38	4.16	5.47	76.02	0.21
Neftedag	25	0.74	2.41	2.98	3.45	3.89	2.92	4.53	5.10	72.07	1.91
Surakhany	80	....	0.89	1.72	4.09	4.72	3.28	5.37	6.95	71.74	1.31
Lok-Batan	55	....	0.60	1.72	2.25	3.71	3.32	4.26	6.78	79.90	1.46
New Grozny area	16	1.10	3.15	3.77	5.09	3.99	3.82	4.32	5.62	67.69	1.45
Old Grozny area	15	1.54	4.88	4.37	6.95	4.12	5.07	4.35	3.11	64.68	0.93
Shor-Su*	55	0.03	0.89	0.69	2.74	3.37	2.81	3.99	3.99	79.89	1.70
Maikop	15	2.71	6.03	7.03	8.41	6.09	4.75	5.46	5.78	51.75	1.99
Krasnokamsk	25	1.18	3.57	3.85	6.05	4.03	5.02	5.04	5.01	65.19	1.06
Syzran*	42	0.08	0.09	0.12	2.44	2.63	3.13	4.28	3.54	82.19	1.50

*Light fractions were partially lost in the dehydration (emulsified crude oils).

TABLE 5

Refractive indices of crude oil fractions (n_D^{20}) and specific gravities of crude oils (d_4^{20})

Crude oil	Cuts °C.								d of crude oil
	Below 60°C.	60-95	95-120	120-150	150-175	175-200	200-225	225-250	
Pirsagat (Alyaty)	.....	1.3938	1.4139	1.4250	1.4354	1.4429	1.4500	1.4564	0.8678
Neftedag	1.3774	1.3990	1.4157	1.4285	1.4394	1.4477	1.4550	1.4628	0.8782
Surakhany	.....	1.4118	1.4178	1.4276	1.4411	1.4505	1.4560	1.4611	0.8563
Lok-Batan	.....	1.4081	1.4228	1.4320	1.4402	1.4484	1.4573	1.4663	0.8818
New Grozny area	1.3637	1.3937	1.4091	1.4208	1.4310	1.4382	1.4452	1.4534	0.8470
Old Grozny area	1.3620	1.3941	1.4091	1.4209	1.4310	1.4388	1.4484	1.4600	0.8360
Shor-Su	1.3880	1.4001	1.4098	1.4272	1.4396	1.4486	1.4576	1.4674	0.8933
Maikop	1.3732	1.4010	1.4116	1.4296	1.4402	1.4485	1.4577	1.4705	0.8253
Krasnokamsk	1.3644	1.3922	1.4070	1.4189	1.4296	1.4380	1.4470	1.4556	0.8572
Syzran	1.3765	1.3956	1.4088	1.4023	1.4324	1.4452	1.4542	1.4602	0.8978

TABLE 6

Contents of non-hydrocarbon components and solid paraffin in crude oils.

Crude oil	Percent, by weight							
	Bases		Strong acids	Phenols and weak acids	Carbenes	Asphaltenes	Silicagel resins	Solid paraffin
	Free	Combined						
Pirsagat (Alyaty)	0.005	0.002	0.001	0.006	0.018	1.296	15.41	12.30
Neftedag	0.015	0.008	0.008	0.539	0.071	1.340	10.90	1.94
Surakhany	0.020	0.007	0.019	0.011	0.000	0.000	2.14	6.35
Lok-Batan	0.033	0.009	0.017	0.022	0.029	0.036	4.86	10.35
New Grozny area	0.015	0.003	0.005	0.009	0.035	0.434	3.10	12.15
Old Grozny area	0.022	0.004	0.021	0.615	0.043	1.129	3.18	4.85
Shor-Su	0.002	0.002	0.008	0.001	0.102	2.312	9.42	6.75
Maikop	0.053	0.010	0.043	0.062	0.024	0.154	3.51	1.95
Krasnokamsk	0.008	0.006	0.004	0.005	0.025	2.098	15.02	4.96
Syzran	0.005	0.008	0.001	0.011	0.026	3.079	16.08	4.36

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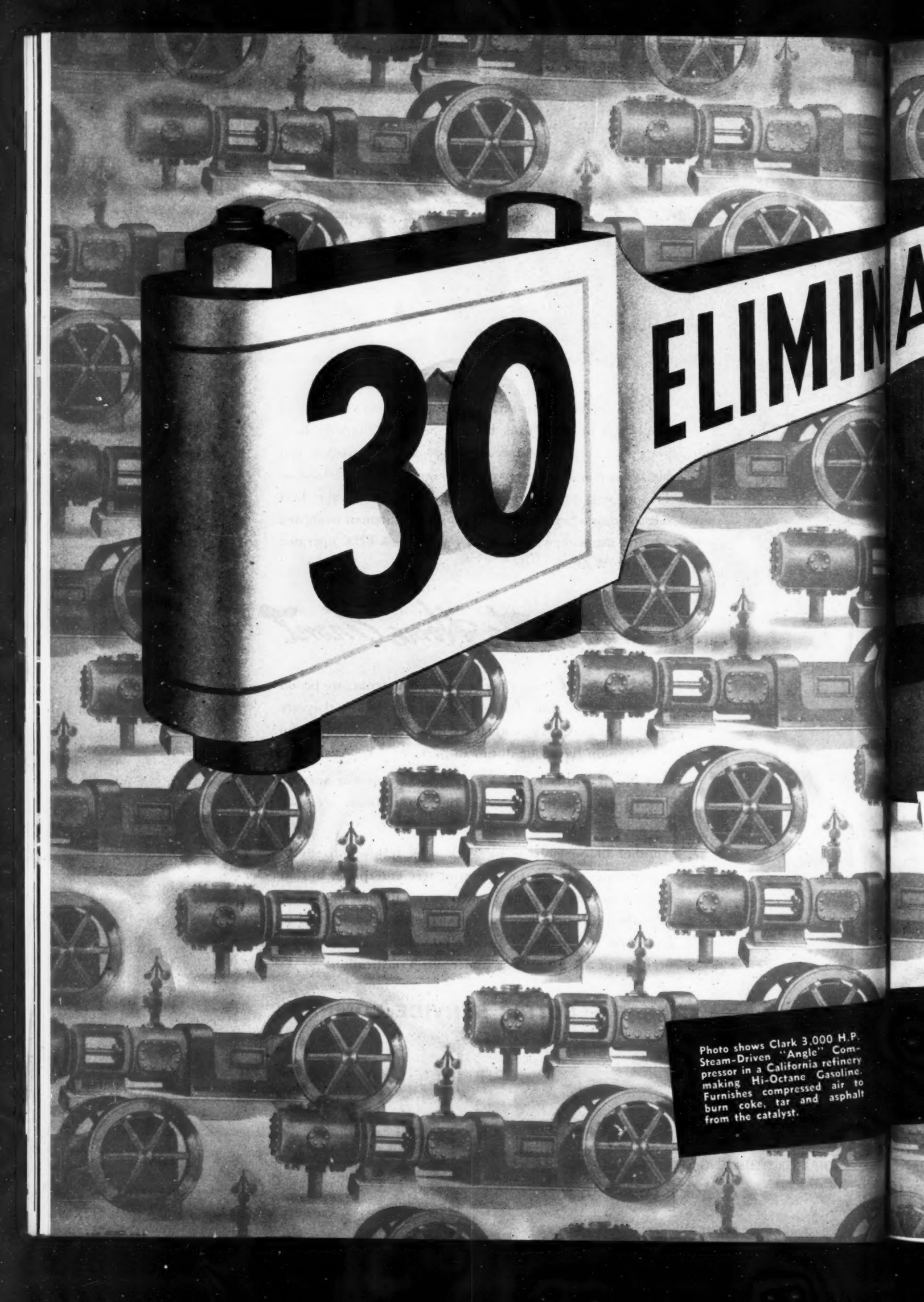

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International Aspects of the American Petroleum Industry[1]

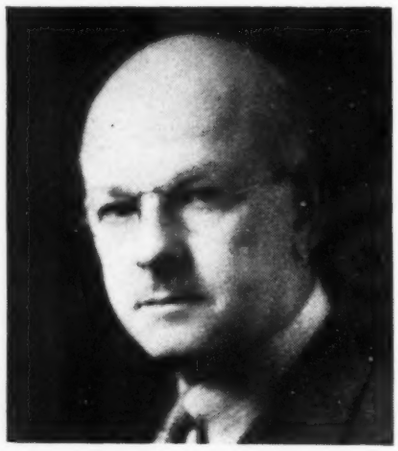
☆ Petroleum to play significant role in postwar world reconstruction

by Joseph E. Pogue, Vice President, The Chase National Bank

THE war has brought about important changes in the petroleum situation and through its stimulating effect upon demand, on the one hand, and its retarding effect on field developments, on the other, has created an entirely new relationship between prospective supply and demand. The record of the petroleum war economy is being written in two chapters, the first of which is nearly completed. The events of chapter one were primarily concerned with the far-reaching transportation dislocations created by the submarine campaign. During the first 18 months of the war the major problems involved the establishment of transportation detours to meet essential requirements with minimum utilization of tankers, and the elimination of all dispensable consumption to ease the load. The shrinkage in tanker availability had to be countered by the development of extraordinary methods of transport overland and the taking of ocean-borne supplies from the nearest sources.

The second chapter in our current oil economy is introduced by a radical improvement in transportation capacity, as a result of the completion of extensive pipe line facilities and the favorable crossing of the curves of tanker construction and tanker sinkings. The breaking of transportation bottlenecks simultaneously on land and sea has fundamentally altered the economic and administrative problems of the oil industry and brings to the fore the elements of supply heretofore hidden behind transport barriers. But the problems of supply were not only masked during the events of chapter one, they were actually latent so long as demand had not risen to the zone of productive capacities. Now, however, the convergence of the trends of supply and demand is creating a new set of problems just as our transportation limitations are eased.

Petroleum production in the United States has enjoyed a rising trend since the inception of the industry, but the basis of production — the discovery rate — has fluctuated in conformance with price, the trade cycle, the emergence of new techniques, and other features. For several years the trend of discoveries has been downward (although some reversal is apparently in evidence in 1943), but whether the decline in the discovery rate is a cyclical manifestation or else a subnormal level of discoveries will continue as a permanent condition is indeterminate, although the latter is perhaps the prevailing view. At the same time the demand for domestic crude oil, augmented by enormous military requirements, has been expanding sharply and against this trend our domestic oil fields cannot long meet the full requirements without strain.



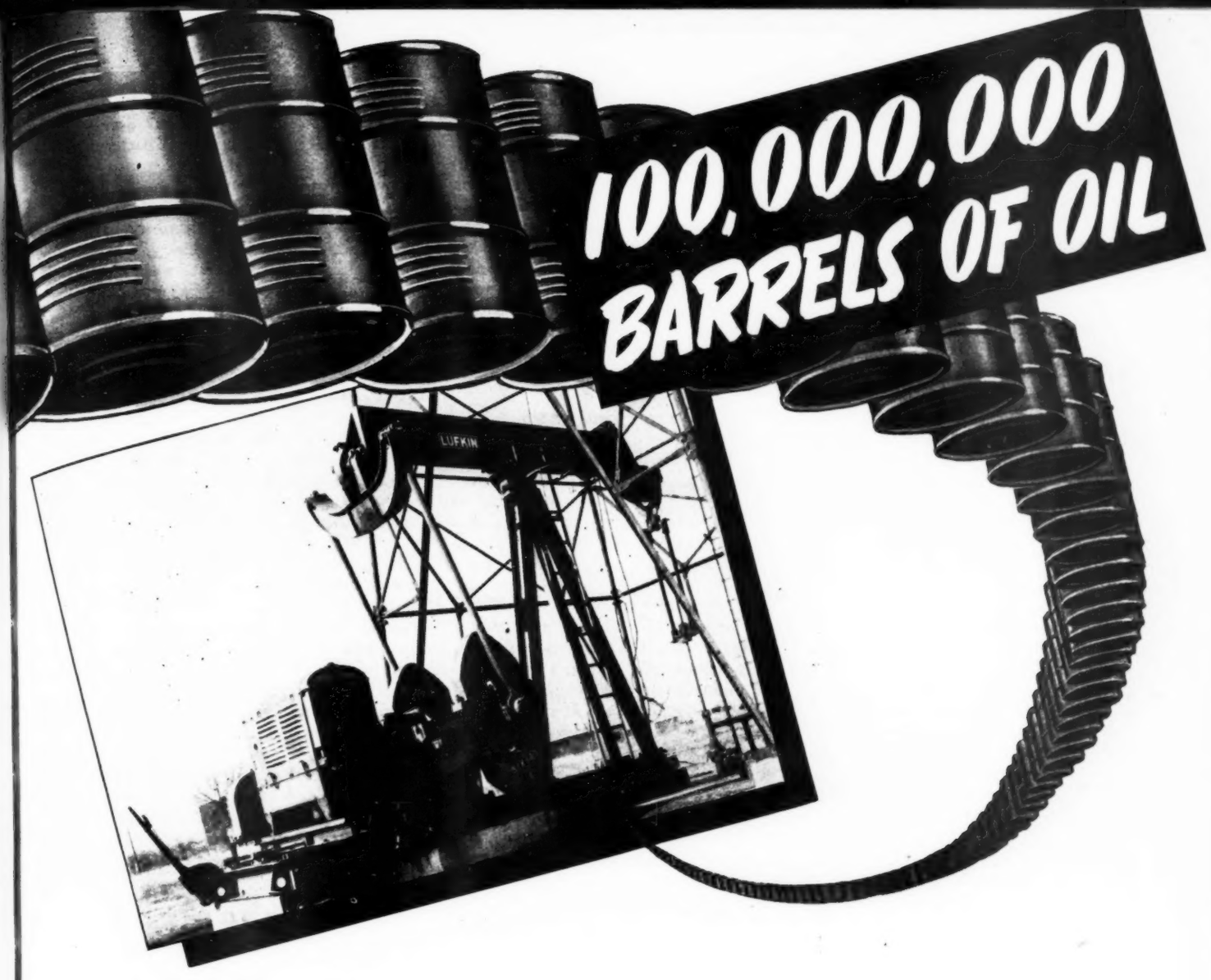
JOSEPH E. POGUE

who has a Ph.D. degree from Yale University, has served as assistant curator of mineralogy and petrology at Smithsonian Institution, associate geologist U. S. Geological Survey, associate professor geology and mineralogy Northwestern University, assistant director Bureau of Oil Conservation of U. S. Fuel Administration during first World War, manager department of economic research Sinclair Consolidated Oil Corporation, leaving that company to enter consulting work—Employed by Chase National Bank in 1936.

When the producibility of the domestic oil reserve is examined in terms of rising requirements, it is found that a limitation is rapidly being approached. The Economics Committee of the Petroleum Industry War Council, in its July report, gave the results of a detailed study in these terms: "... for 1944 and 1945 the oil fields of the United States should not be counted on to produce *without waste* (italics mine) more than 4,200,000 to 4,300,000 bbl. of crude oil per day . . . . " Domestic production, which understates demand because crude oil stocks are being drawn upon, crossed 4,200,000 bbl. per day in August, so that the estimated zone of maximum efficient production for American oil fields has already been invaded.

Production experience over the last 15 years has thoroughly established the principle that if production in any field is allowed to exceed a certain level called the optimum, or maximum efficient rate, there is both a loss in ultimate recovery and a subsequent decline in producibility, perhaps on the average to the extent of 25 percent. Production in excess of the maximum efficient rate for the country at large should be avoided if possible and resorted to only in case of sheer necessity. In the face of a demand such as is now in prospect, there are only four ways in which wasteful production can be avoided. First, civilian consumption might be restricted in further degree, but aside from more effective enforcement of gasoline rationing there is little slack to take up on this score without encountering the danger of impairing the domestic economy. Second, higher prices or tax abatement measures could stimulate discovery and producibility, but there has been long delay in invoking these developments. Third, military and lend-lease demands might be reappraised in the light of the new conditions and adjustments may be possible in this field. Fourth, the allocation of demand to available sources of supply could be placed on a world basis and a more efficient flow-pattern developed and induced by the development of facilities appropriate to this end. Gain can doubtless be made in all four categories, but an effective safeguard against wasteful production and unnecessary depletion of the domestic resource requires a world basis for supply.

[1]Presented at Annual Meeting, National Petroleum Association, New York City, September 21, 1943.



ONE HUNDRED MILLION BARRELS is a lot of oil, yet that figure represents the amount of increased consumption over the amount consumed in 1942.

51,000,000 barrels more oil were consumed the first eight months of 1943 than were consumed during the same period in 1942.

1944's armed forces demand is now estimated at 1,485,000,000 barrels. And, there is a possibility this figure may be revised upward.

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Fortunately the importance of a balanced world program for the production, refining, and shipment of oil is fully appreciated in many quarters and the techniques are available for its implementation. What is needed is a more balanced allocation of world demand to all available sources of supply. It is believed that a fully integrated effort along the lines indicated above can obviate the undue impairment of the domestic oil resource. It is to the interest of both the war effort and the domestic economy that this be done, and the improving tanker situation makes this possible.

It is well known that the reserves and producibility of oil in the Middle East and in the Caribbean region are much greater than now utilized. Reserves in the two areas combined are larger than in the United States, whereas producibility from existing wells is several hundred thousand barrels per day in excess of recent takings. True, the limitation in both areas is refining capacity and to some degree pipe line transportation, rather than producibility, but these bottlenecks can be broken by further installations, on the one hand, and a freer international movement of the oil, on the other. And producibility can be radically augmented by additional drilling.

Whatever the administrative disposition of the problem may be, the economics of the petroleum situation indicate that the oil resources of the Middle East and of the Caribbean region will be drawn upon more fully for war purposes, and future increments to the military demand will be diverted more and more to these sources. In fact, this shift is already well under way. It is clear, therefore, that for the duration of the war the American petroleum industry has become indissolubly linked with foreign sources of supply and no major domestic oil problem can now be resolved except in the light of all foreign alternatives.

At the very core of all production thinking is the rate of production and particularly the best rate, all factors considered—the rate that has been termed the optimum, or maximum efficient rate. This is the most fertile concept, or discovery, that has emerged from our production experience and it is almost axiomatic that it is unsound to produce any oil field in excess of its optimum rate. It is also important to understand that a field may be soundly produced below its optimum, if economic conditions require. The application of the optimum rate, therefore, is not symmetrical in an administrative or economic sense. The economic cost of exceeding the optimum is much greater than that of falling short of it—the first having social implications, the second merely delayed monetary realization. We may therefore set forth the following principle, which is thoroughly grounded in established practice and in conservation policies as followed by the state regulatory bodies and the Interstate Oil Compact Commission; namely, the oil fields of the United States should not normally be produced in excess of their aggregate optimum rate nor should they be operated below their optimum rate except to avoid over-production.

At any given time the optimum rate of crude oil production in the United States must exceed, equal, or be less than demand. In the first case, the pressure of supply will tend to create an excess of exports over imports; in the second case, the balance of trade in oil will approach zero; whereas in the third case, foreign oil will be required to fill the margin and this nation will become a net importer of petroleum. The domestic optimum rate, accordingly, will be the ultimate determinant of the position of this country in respect to imports and exports of oil. But whatever these relationships may turn out to be, the organizing and technical ability of the American petroleum industry should have a great role to play in the development of oil resources the world over.

The industrial advancement of the world in the postwar period depends more upon transportation than upon any other single factor. No other instrumentality has had a more profound influence upon the world order. Transportation is a stimulant of production and in its presence natural resources and technology combine to create useful commodities; but transportation is not a static concept; it is itself undergoing change. The type of transportation that accompanied and supported industrial developments in the past will have altered and become automotive transportation in the era of reconstruction and expansion that will characterize the postwar period. This charge in the form of transportation has been so long under way and its future implications are so obvious as to require no further elaboration here. Petroleum is essential to support the development of the transportation facilities necessary to create rising standards of living based upon expanding production and trade. In this light, petroleum and the industrial structure through which this resource functions take on a pivotal character of the first importance. It is scarcely too strong an assertion that the future of the postwar world is dependent upon the disposition made of petroleum as an economic and social force.

The petroleum industry has developed techniques and operating patterns that will prove invaluable in postwar expansion throughout the world. In addition, it has demonstrated a peculiar genius, derived no doubt from the pioneering aspects of the industry, which is difficult to describe and to make clear to anyone who has not lived with this subtle element. It is this genius that has been instrumental in discovering nearly all oil found in the entire world outside of Russia, and its techniques have been contributory to developments there. It is this genius that has in the last ten years developed in the United States, against almost impossible legalistic odds, a system of efficient production reconciling competition with the advantages of cooperation in oil pools of divided ownership, adapting for this purpose a workable form of collaboration between the individual operators and the oil-producing states — thus revolutionizing engineering practices, equities, and political-economy in our oil fields. It is this genius that has facilitated the development during the war period of a system of dual planning and management whereby government and industry are collaborating in the task of directing the complex pattern of petroleum operations to war objectives. These experiences, together with its command of technology, not only fit this industry for participation in the execution of postwar international oil policies but make it essential that its understanding be drawn upon in the formative period of thinking and planning toward those ends.

The problem of postwar world reconstruction cannot proceed along sound economic lines without the establishment of petroleum in a role consistent with its importance. For this purpose it is necessary that the United States formulate a foreign policy that will at the same time serve the interests of our country and further the productive capacity and volume of trade of foreign countries. Such a policy should be friendly to American enterprise, which has demonstrated its ability in oil developments the world over, and should have the objective of making foreign oil activities commercially attractive so as to create a dynamic urge toward further progress. To these ends our nationals will need freedom from burdensome operating controls, stability of contracts, and parity with all competitors. If these conditions are provided by international understanding, this country and its petroleum industry can make an outstanding contribution to the future stability and well-being of the entire world.

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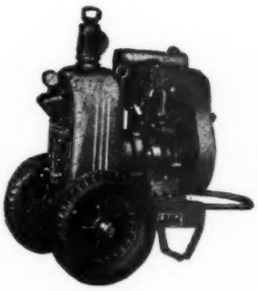

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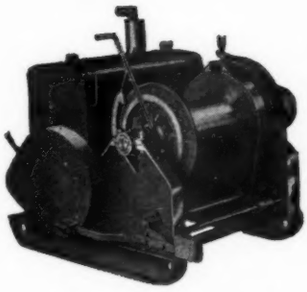

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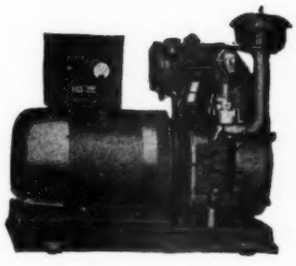

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Recourse: According to Webster, "*a going to for aid or protection*"

Exploitation of Athabaska Tar Sands[1]

☆ **Canadian government's program expected to determine commercial possibilities**

FOR 30 years the tar sands of Alberta, at and around McMurray, have been under investigation by engineers of the Department of Mines and Resources.

Although it was known that there are large deposits of these sands, there were, and still are, many problems to be solved before they can be commercialized and/or can be used to produce marketable products such as gasoline, Diesel oil, fuel oil, etc.

The following problems had to be solved:

1. Economic methods of mining the sands.
2. Separation of bitumen from the sands.
3. Treatment of the bitumen after it is separated to produce marketable products.
4. Removal, or at least substantial reduction, of the high sulphur content of the crude products obtainable from the extracted bitumen. With the high sulphur content of the bitumen there is consequently high sulphur in the lighter fractions, i.e., gasoline, Diesel oil, etc. This sulphur must be removed to obtain marketable products.
5. A thick uniform rich deposit of sands with a light overburden had to be found.
6. A solution had to be found for the disposal of the overburden and waste so as not to pollute any navigable stream or body of water. When it requires a ton of sand to produce a little less than a barrel of bitumen in a deposit of the type of Horse River, the magnitude of the tonnage of tailings to be disposed of can be understood more readily.
7. Transportation had to be found for the movement of the products to the market at reasonable cost.

Since 1913 field and laboratory investigations have been conducted by the Federal Department of Mines and Resources. These include laboratory studies of methods for separating the bitumen from the sand and refining of the bitumen by cracking and hydrogenation for the production of sulphur-free commercial products.

In 1926 four reservations, aggregating 2068 acres, were made by the Parks Branch of the Dominion Government in order to ensure an adequate supply of road surface material for national parks.

In 1930, the national resources, including these tar sands, were transferred by the Dominion to the Province of Alberta, reserving, however, the 2068 acres for the Parks Branch.

In 1930, Max W. Ball of Denver, Colorado, entered into an agreement with His Majesty, King George V, represented by the Minister of the Department of the Interior, which department has since been amalgamated with the Department of Mines and Resources, to mine bituminous sands on the Horse River block and to extract therefrom the bitumen and other hydrocarbons contained therein, on a basis whereby a share of the resulting products would belong to His Majesty for the benefit of national parks. This original agreement was superseded by an agreement entered into on February 18, 1935, which was later assigned to The Canadian Northern Oil Sand Products, Ltd. This company changed its name by supplementary letters patent under date of April 25, 1935, to Abasand Oils, Ltd. The present agreement was entered into on February 18, 1942.

Preparations were made in 1935 by Abasand Oils, Ltd., for the construction of a separation plant on Horse River having a capacity of 250 tons per day. This plant was completed in September, 1936; it operated a short time, sufficient only to indicate that certain modifications were necessary. A road was also constructed by this company from the plant to Waterways.

In 1937, an enlargement of the plant to a capacity of 400 tons per day, together with a refinery, was begun on the same site. Due to difficulties in mining the sand, construction was discontinued temporarily and resumed in 1939. This plant was finally completed in 1940. Subsequently a small pipe line was built to Waterways, which is the terminal of the railroad from Edmonton and the shipping point for northern areas.

Production began again in May, 1941, but again mining difficulties were encountered and production declined. Further, there were only intermittent operations.

In November, 1941, the separation plant and power house were destroyed by fire and all production ceased. In 1942, the plant was rebuilt.

By agreement of February 18, 1942, Abasand Oils, Ltd., was granted the exclusive right to a tract consisting of 100 acres, being part of the 581 acres on Horse River, and retained by the Federal Government for parks purposes. Abasand was to have the right to mine and process bituminous sands therefrom, to sell and transport products made from these sands and erect such buildings and install such equipment as necessary. The operator undertook the following: (a) to erect on the tract a plant capable of extracting the bitumen from 250 tons of sand per day; (b) to erect and equip a refinery in the Province of Alberta to manufacture gasoline, asphalt, and other products, to the satisfaction of the minister of mines and resources, and (c) to mine and treat 25,000 tons of sand in the year 1942, subject to certain terms and conditions set forth in detail in the agreement itself.

Investigation

The oil controller was appointed in June, 1940, and in July of the same year had his first meeting with officials of Abasand Oils, Ltd. At that date the Abasand officials were satisfied that they had developed the McClave process for the separation of the bitumen from the sands to a point where they could proceed with a solution of the other problems involved. At that time the problem of mining the sands was giving them serious concern. They were developing a shale planer. Within a few months, however, this method proved a failure and was abandoned. Shortly afterward, operations ceased for that year.

Again, in the spring of 1941, Abasand Oils, Ltd., renewed activities toward a solution of their many problems; mechanical difficulties were constantly encountered. As a result, a continuous run of the plant was impossible, and it was impossible to procure a sample of the bitumen required for research purposes. In the fall, as hereinbefore stated, this plant was burned down and, obviously, all operations had to be suspended.

Owing to the urgency of the situation and in the hope of speeding up the solution of the many problems yet to be dealt with, the government entered

[1]Material for this article supplied by the Office of the Oil Controller of Canada.

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into an agreement with the Consolidated Mining and Smelting Company (the cooperation of Abasand Oils, Ltd., was obtained), and an appropriation of $75,000 was made to carry out the work (this appropriation was later increased to $200,000). Consolidated Mining and Smelting Company undertook the work without profit, but on the assurance that they would suffer no loss. Abasand Oils, Ltd., gave assurances that their plant would be reconstructed early in the summer and they would be in a position to carry on a continuous operation, from which they could make studies of the success of the McClave process, etc., and procure samples to determine what products could be produced from the bitumen, and estimate costs of the operation. To this end negotiations were carried on by the oil controller with the Office of the Petroleum Administrator for War in Washington, D. C., with a view to having organizations in the United States make thermal and catalytic cracking, and hydrogenation tests of the samples, particularly in respect to the possibility of obtaining aviation gasoline, motor gasoline, Diesel oil, and fuel oil. As a result, arrangements were made for laboratory tests by Universal Oil Products Company of Chicago, Illinois, on thermal and catalytic cracking, and by Standard Oil Development Company of Baton Rouge, Louisiana, on hydrogenation. Inasmuch as hydrogenation on a large scale would require an expenditure of possibly $12,000,000 or more, the research by Universal Oil Products on thermal and catalytic cracking was considered advisable as, if it were successful, the cost (although substantial) would be less.

Unfortunately, the plant of Abasand Oils, Ltd., as reconstructed after the fire, could only operate intermittently, and the information that it was hoped to get from this plant was not obtainable. Further, owing to bottlenecks in the plant, it was impossible to procure samples of the bitumen of the type required for research investigation to give the quickest results, and it was impossible to procure the quantity of bitumen necessary for the plant test at Baton Rouge.

Agreement

Under the agreement with Consolidated Mining and Smelting Company, Ltd., the company undertook the following:

(a) Test drilling of the bituminous sand areas in the vicinity of Fort McMurray, Alberta, to provide reliable information regarding the location of areas that might support large-scale development for production of oil on a scale of 10,000-20,000 bbl. per day.

(b) Study of the plant of the Abasand Oils, Ltd. (hereinafter referred to as "Abasand"), near Fort McMurray with regard to costs, efficiency, etc.

(c) Research to discover what kinds and qualities of products can be produced from the bitumen extracted from the oil sands.

The report of Consolidated reads, in part:

Deposit. There are tremendous deposits of oil sands in the McMurray area but much of this area is overlaid by heavy overburden and lean oil sands. The exploration problem was to find an area with a large tonnage of high grade sand under light overburden with necessary natural advantages for a plant site. Two areas judged from previous work to be the most promising were selected for drilling. The drilling done showed clearly that the deposits are generally interlayered with clay and lean sand and vary widely within short distances, both horizontally and vertically, to a greater degree than had been expected.

We are of the opinion from the results to date, that large tonnages of high grade sand similar (about 16 percent bitumen and 5 percent minus 200 mesh) to that now being treated by Abasand will not be readily found. Large tonnages of sand containing about 12 percent bitumen and high in minus 200 mesh material (25 percent) could probably be readily blocked out. Until complete data on capital cost, operating costs, and details of products that can be produced are available, it is impossible to determine the minimum grade of sand that will make an operation a practical proposition. In any case, from the operating costs quoted later it will be seen that a thorough search for a high grade deposit is very desirable.

The Wheeler Island area was the first of the two areas selected for drilling. Twelve holes were drilled in this area, indicating a substantial tonnage of sand about 12 percent bitumen. The high content of minus 200 mesh mineral matter in the sand, and the occurrence of clay and shale lenses, make it undesirable for large scale development. If better areas are not found, however, this area still has possibilities.

Second area selected for drilling was the Steepbank River area. In this area a bench under light overburden and adjacent to a suitable plant site has an indicated tonnage of 30,000,000 tons of oil sand averaging about 12 percent bitumen and 18 percent mineral matter minus 200 mesh. Of this tonnage approximately one-third may be appreciably better in grade.

In addition to the sand in the bench, there is a considerably larger tonnage of sand, of similar grade, under overburden of about one-half ton per ton of oil sand.

Drilling at closer spacing must be done before the above indicated tonnages and grades could be used as a basis for location of a plant.

Mining. The present Abasand system of mining by light blasting, loading with power shovels, and trucking to separation plant is quite practicable under summer conditions. Under winter conditions it will undoubtedly present problems but these are considered to be more a matter of increased costs than technical obstacles. Unfortunately Abasand did not operate in sub-zero weather and winter conditions could not be observed.

Separation. The plant of Abasand is not a fully developed commercial unit and its operation to date has been intermittent and erratic; hence its operating costs and its production of marketable products are of little value in this investigation. The process has been developed to the point, however, where the general plant design data and operating efficiency figures of this operation can be used as a basis for estimating the possibilities of a large scale separation plant.

We are of the opinion that the process of Abasand Oils, Ltd., for separating the bitumen from the sands is a practicable one, which could be used in a large scale plant and which would yield reasonable results. Recoveries in the separation plant were consistently greater than 90 percent, and there is no reason to doubt that these figures could be duplicated in a large scale plant provided sand of the same bitumen content and clay content were being treated. Two important unknowns in the Abasand separation process are:

(a) The effect of an increase in the clay and fine sand content of the feed on the recovery of bitumen.

(b) The effect of severe winter conditions on the capacity of the plant.

Due to inadequacies in the equipment, Abasand was unable to demonstrate the reputed "digestion" characteristics of the bitumen and the production of a pumpable crude by such digestion. This digestion is one of the cornerstones on which much of the potential value of the bitumen and its processing is based, and Abasand is now arranging to modify their plant to prove this digestion and to improve the operation with regard to diluent production.

The product research study was not authorized by the government at the time the other phases of the investigation were begun. Arrangements have now been completed with Universal Oil Products Company to carry out a research program on bitumen, including a complete crude evaluation and a study of the possibility of producing aviation gasoline and other products by

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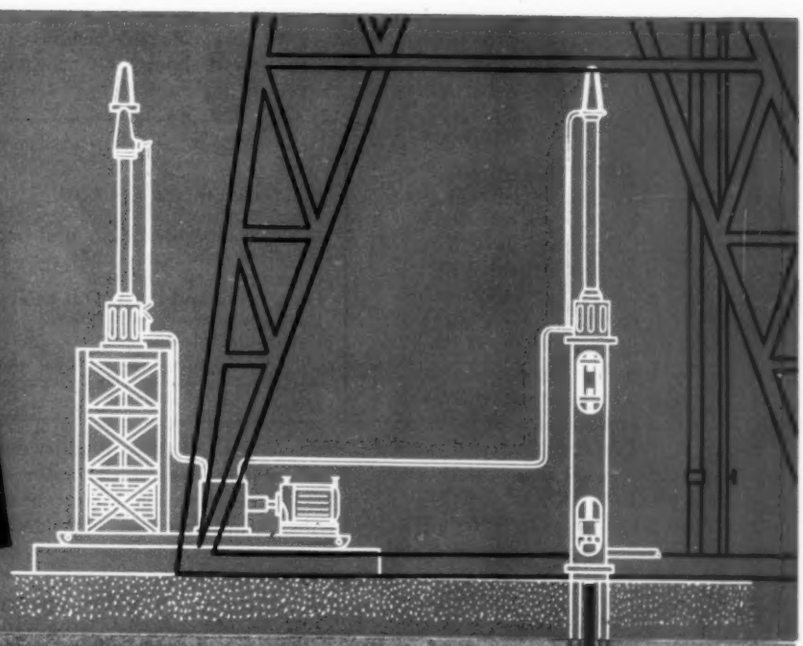

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Ask for Bulletin 43-24; it illustrates and describes the many features of Vickers Hydraulic Pumping Units.

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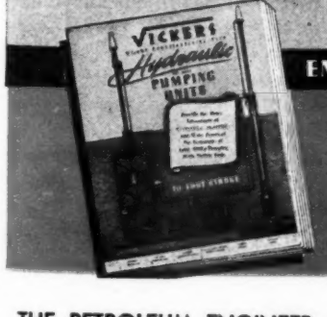


ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Write FOR BULLETIN 43-24

This bulletin describes and illustrates the many advantages inherent in Vickers Hydraulic Pumping . . . how it makes practical the economies of long stroke pumping with sucker rod.

thermal and catalytic cracking. Tests are now under way.

Negotiations are under way with Standard Oil Development Company with a view to determining the applicability of hydrogenation to the refining of the bitumen.

One of the difficulties in the way of making marketable products from this raw material is the high sulphur content of the products obtained from it. Methods for the removal of the sulphur from the gasoline fraction will have to be developed before it can be sold as graded motor gasoline or as aviation gasoline.

Cost of production. Cost estimates can only be made on the basis of producing refinery crude oil and this can only be roughly indicative until the engineering and design estimates of the plant are made and until definite information has been obtained on the following questions, viz:

(a) The deposit to be mined.

(b) The production of a pumpable crude oil from the separated bitumen without excessive cracking and with diluent recovery in balance with the separation plant.

(c) The effect of winter temperatures on the mining and separation processes.

(d) The effect on the Abasand separation process, of high percentages of minus 200 mesh material in the sand.

(e) Complete information on the ordinary petroleum products obtainable from the bitumen.

Investigation costs. As it was understood that speed was the essence of the contract, work was begun as soon as possible after the government's request. It must be pointed out that time was not available for adequate normal planning and preparation and for this reason work was begun with equipment that was in some respects inadequate for the job. These inadequacies were corrected as soon as possible but they nevertheless reflected unfavorably on progress and costs.

It should also be stated that the summer of 1942 was a difficult season in which to carry out an exploration program in the McMurray area. The generally acute conditions of labor supply, of purchasing supplies and equipment, and of obtaining transportation were aggravated in the McMurray and Edmondton areas by the United States "Canol Project" as well as to a lesser extent by the work on the "Alcan Highway."

Summary of costs of investigation to date:

Expenditure to December 31, 1942	$ 93,834.96
Commitments and estimated expenditures for January, 1943	18,622.89
	$112,457.85

Recommendations. If the results of the investigation to date with those of the crude evaluation test now under way, are such that they interest the government to the extent of immediate and extensive action, it is suggested that they proceed on a plan as follows:

(a) Endeavor to prove the Steepbank area by closer spaced drilling.

(b) Continue reconnaissance drilling, as an increase in the grade of sand from 12 to 15 percent bitumen means a reduction of about 5000 tons daily or 25 percent in the quantity of sand to be mined and handled to produce 10,000 bbl. per day. Hence the value to be placed on exploration in relation to the final project is very real and should not be underestimated in deciding on immediate procedure.

(c) Arrange with Abasand to expedite the contemplated changes in separation plant and refinery so that the production of a pumpable crude can be demonstrated and more complete operating data can be obtained.

(d) Follow up energetically crude evaluation research program.

(e) Organize an engineering staff to prepare preliminary plans of necessary plants and assess generally the full economics of the project with respect to capital expenditures, operating costs, transportation, and marketing aspects.

Such a program as outlined above will be expensive and difficult under present conditions of labor and material supply but if a large scale development is at all probable such work is essential.

The only further exploration authorized at present is drilling on Horse Creek area, as instructed by your Department. Even if drilling proves the sand to be of suitable grade, this area has only sufficient sand for small scale operation and we believe that such a plant would be better situated at a point where expansion to large scale operation is possible. The advantage at Horse Creek of proximity to rail transportation is outweighed by the topographic and overburden characteristics, which would make the operation a relatively expensive proposition and which would eliminate any possibility of a plant larger than about 2000 bbl. capacity.

We consider that results in the Steepbank area are sufficiently promising for large scale development to render unnecessary any consideration of a small plant at Horse Creek so far as this investigation is concerned; and consequently the proposed drilling would be better undertaken at Steepbank. We would point out that we are considering the whole subject from the point of view that any development has for its final objective a large scale permanent industry.

The following are extracts from the appendix to the reports:

Summary of operations, 1941-42

	1941	1942
Separation plant operated days and part days	132	70
Total virgin crude produced (bbl.)	20,282	9,958
Refinery operated days and part days	121	82
Gasoline produced (bbl.)	933	712
Gasoline used (bbl.)	226	406
Diesel fuel and burner oil produced (bbl.)	2,609	3,177
Residuum produced (bbl.)	10,801	7,278
Residuum burned (bbl.)	9,473	5,900

N.B.: These figures are taken from the daily reports of Abasand Oils, Ltd. Their accuracy is not guaranteed and they are quoted only to give a rough idea of the quantities of the various products produced.

Mining. Overburden removal in early operation was by a Sauerman excavator. This did not prove satisfactory and at present a power shovel and trucks are being used.

The selection of the method of removing overburden to be used in a large scale development can only be made after the plant location has been chosen and all the various factors such as topography, disposal areas, etc., have been studied.

In the preliminary consideration of costs it has been assumed that power shovels and trucks will be used for both overburden removal and sand mining.

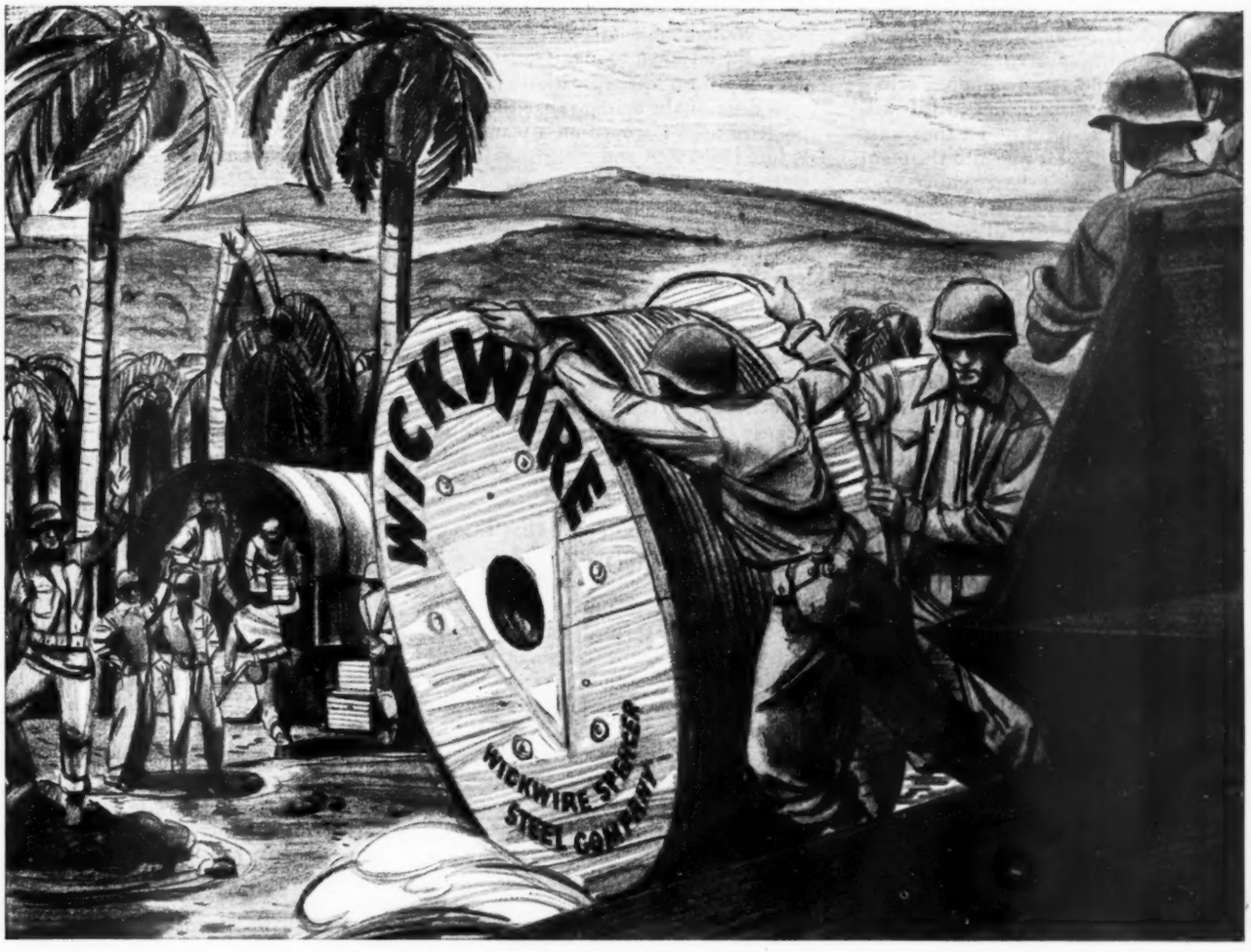
The first sand mining at Abasand was done with a shale planer. This equipment soon proved unsatisfactory. The present method entails light blasting of the sand, excavation by power shovel, and transportation to the plant by truck. This method seems feasible for handling large tonnages.

The drilling and blasting operations were studied during the summer. Drilling is done with steam jets, and low grade blasting gelatin is used for blasting. This method appears to be quite satisfactory during the summer but no knowledge was obtainable on winter operations. Secondary blasting may be required in cold weather.

Separation plant. In the above key figures for October 16-21, 1942, it will be noted that 43.5 percent of the plant production was used as plant fuel in the period quoted. This high consumption of fuel is due to the following:

(a) The plant was running at less than its normal capacity, therefore heat losses were large in proportion to production.

(b) Insulation of separation plant



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These buddies of ours know that *you* need Wickwire Rope, too—to help in your speeded-up *production* of lots of things for them. So they're grateful when you make each length you now have last longer, so that more Wickwire Rope can be used to equip the Liberty Ships, and to send overseas.

But when you do need more of this friendly Wickwire Rope to help maintain your war-production pace, won't you please order it *without* reels, if lengths will permit, so that handier reels can be spared for the boys out there? Wickwire Spencer Steel Company, 500 Fifth Avenue, New York.

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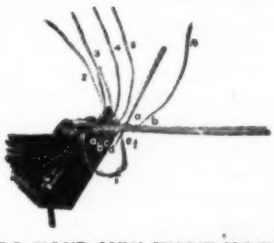
Wickwire Spencer was the first manufacturer in all New England to be awarded the Maritime M and Victory Fleet Flag for outstanding production accomplishments!



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equipment is not effective and no attempt is made to prevent loss of heat by evaporation of water from open cells.

(c) Plant water is discarded with the tailing at about 150°F., thus wasting most of the heat put into the plant.

The questions of heat conservation and recovery are very important ones and must be given careful consideration in the design of a new plant if the marketable products are to form a high proportion of the total production.

The equipment in the Abasand separation plant is largely standard equipment and little difficulty is anticipated in adapting the process to a large scale operation. The chief step that has not been developed satisfactorily is the feeding of the tar sand to the plant.

Two important unknowns in the Abasand separation process are:

(a) The effect of an increase in the clay and fine sand content of the feed on the recovery of bitumen.

(b) The effect of severe winter conditions on plant operations and capacity.

It is thought that both of these problems can be solved, but it would be advisable to have more information in order to make the plant design as satisfactory as possible.

Although the Abasand plant operation during the investigation was intermittent and inefficient in many respects, this was due not to inherent technical weaknesses in the process but to poor equipment and the general plant layout and design. We believe that a well designed and equipped plant based on the present process would give satisfactory operation.

Refinery. The only marketable product produced in appreciable quantities by the Abasand refinery is Diesel fuel. A small quantity of gasoline is produced for plant consumption. Any excess of residuum over plant fuel needs is distilled to coke, the coke so produced being burned under the plant boilers. The light oil from the coking operation is charged to the pipe still along with the diluted crude produced by the separation plant.

The quantities and qualities of the products from the Abasand refinery have no bearing on this investigation as the potential value of the bitumen can only be estimated on the basis of products from modern processes and equipment.

It will be sufficient to note that the following important questions were not proved in operation:

(a) That "digestion" or viscosity breaking of the bitumen at moderate temperatures and pressures will produce a product that can be satisfactorily pumped to a distant refinery.

(b) That "digestion," besides making the bitumen pumpable, will produce enough of a satisfactory diluent from the bitumen to maintain the diluent supply for the separation plant.

We are of the opinion that the above points must be proved on a plant scale before the design and construction of a large plant is undertaken.

This outlines in part the investigations of the Consolidated Mining and Smelting Company during the year 1942, and January, 1943.

The statements contained in this report, in addition to providing valuable data, confirm what engineers of the Department of Mines and Resources, and the oil controller, have maintained; namely, that there are many difficulties to be overcome before crude oil in substantial quantities and marketable products therefrom are obtainable from the tar sands. It was hoped that the activities of Abasand Oils, Ltd., would find the solution to these problems, but this is not the case and possibly should not have been expected.

Everything seems to hinge on the results of the research investigation now under way in the United States and the establishment of a proper small test plant to prove or disprove the processes that are recommended and decided upon.

Abasand Oils, Ltd., may have developed a separation process; that is, a process to separate the bitumen from the sands. It will be noted, however, that Consolidated in its report made repeated references to minus 200 mesh mineral matter in the sand. Minus 200 mesh means fine sand. If the sand is finer than that on Horse Creek then it becomes a question whether the McClave process (used by Abasand) can be applied to finer sands. Unless there is a recovery of a higher percentage of bitumen, which contains a small amount of sand, it may not be possible to treat the bitumen as desired.

Further, separation is only the first step in winning the oil from the sands. There may be no doubt that asphalt and asphaltic oils can be produced from separated bitumen without further research. Refining processes necessary to the production of other petroleum products, such as gasoline, Diesel oil, etc., have not yet been developed. As is pointed out in the Consolidated report, the assertions of Abasand regarding what digestion will do have not been proved.

In the light of what is known, the conclusion has been reached that Abasand Oils, Ltd., should not be expected to undertake at its expense the establishment of a suitable test plant and the investigation necessary to determine one way or another the value of the sands for the production of crude oil and petroleum products therefrom.

The financing at least of the test operations should be the responsibility of the federal government.

Abasand has the only plant in operation and it has a separation process that works fairly well with the relatively coarse sand found on the Horse River Reserve. As time is of the essence, it is advisable that the present Abasand plant should be used as a nucleus for the test plant, reconstructing and adding to it as may be necessary or desirable.

Accordingly, the government has entered into an agreement with Abasand whereby the present plant is to be rehabilitated and operated on behalf of the government. To that end the board of directors of the company has been reorganized to include men of experience and standing. John Irwin of Montreal, president of Canadian Oil Companies, Ltd., has been elected president. E. A. Smith of the same company has been elected vice-president and appointed managing director. Other members of the board are H. R. Milner, K.C. of Edmonton, Aubrey Davis of Newmarket, and P. A. Thomson of Montreal. E. A. Smith will move to Edmonton shortly to take direct charge of rehabilitating the plant and conducting the test operations.

Although there have been many reports from geologists on the deposit, none of these reports provided a solution for the extraction of the bitumen from the sands and the removal of the sulphur content necessary to make a product of quality. Certain of these geologists have been associated with large oil companies, but they do not appear to have been successful in interesting their principals and/or associates in a solution of the problem. There is no more aggressive body of men in industry than those directing the large oil companies. They have explored all likely areas in the world to obtain supplies of this precious product, oil, and it is significant to note that they have turned away from these sands rather than undertake the solution of the many problems incident to their development and the production of products equal in quality that can be sold at competitive prices with the same products procured elsewhere.

An initial appropriation of $500,000 has been arranged and a program has been drawn up that will link the test plant with research laboratory tests now under way in such a manner as to demonstrate what petroleum products can be manufactured from the bitumen, the quality of the products, and the cost of producing them. It is confidently believed that this program, carried through with federal funds, will answer the question of whether or not the Athabaska tar sands are capable of, or merit, commercial development.

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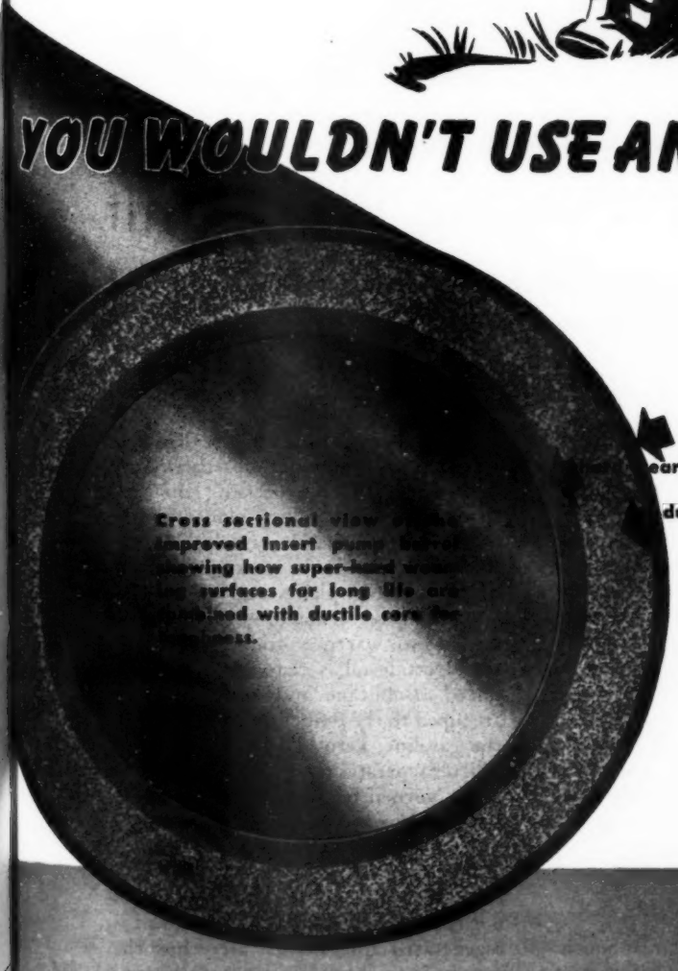

Cross sectional view of the improved insert pump barrel showing how super-hard wearing surfaces for long life are reinforced with ductile core for toughness.

You could... *but you wouldn't if you could get one with a handle.*

Similarly, there is no need to use pumps with untreated barrels when you can get 4 to 8 times harder barrels that wear 2 to 5 times longer. Using equipment that only gives a fraction of the service it should is not the way to win a war. Why be satisfied with untreated barrels when Flupaco Pumps, equipped with super hard barrels, *cost no more* than pumps using cold drawn barrels? Get the complete story on how Flupaco Hardened and Honed Barrels increase pump life!

The unprecedented hardness measurements of Flupaco hardened and honed barrels (shown in the accompanying chart) account for the outstanding performance records of Flupaco Pumps.

	BRINEEL	ROCKWELL
FLUPACO HARDENED AND HONED PUMPS	627	64 to 70-C
UNTREATED STEEL PUMPS	150 to 170	6 to 14-C

Here's an outstanding achievement of modern metallurgy—a one-piece pump barrel which is both hard . . . and tough! While most pump barrels are either hard (and brittle) or tough (and not so hard), Flupacos combine both these important advantages in the one barrel. They have a super-hard wearing surface which measures 64-70 on the Rockwell C scale, and a tensile strength of 145,000 p.s.i.—all in the same piece of metal!

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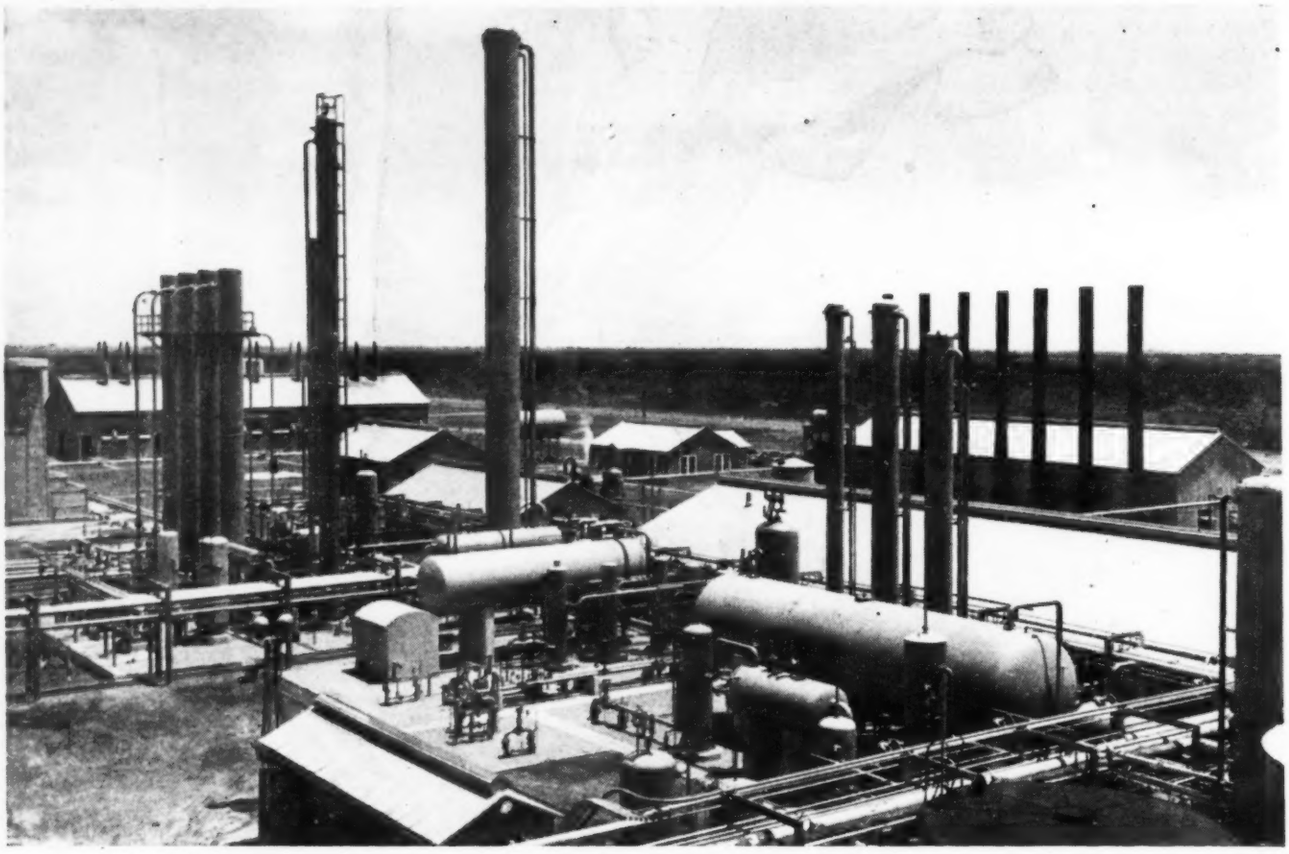

The Chicago Corporation Wardner plant absorption and stabilization areas

First Integrated Refinery-Cycling Plant Unit

PETROLEUM ENGINEER Exclusive Feature

☆ **Four cycling plants, pipe line station, and refinery coordinate operations for wartime production**

by C. C. Pryor, Associate Editor

THE first integrated refinery-cycling plant unit designed to operate on specially fractionated cycling plant cuts for the manufacture of high-octane aviation gasoline and other products is nearing completion in South Texas. This integration combines the recommendations and predictions frequently promulgated by various engineers and informed authorities in the refining and cycling industries and is the result of three years of planned coordination by the participating companies. The accumulation of engineering and operating data and a study of resources have been combined into the wartime integrated unit at a total cost of about $10,400,000. The independent companies, which operated cooperatively in peace times, have doubled their efforts and the size of their plants for cooperative wartime production.

Four companies are represented in this progressive new method. The Chicago Corporation operates three cycling plants in the Stratton field, each one having a capacity of 125,000,000 cu. ft. per day. With the aid of the Defense Plant Corporation the company is installing additional equipment at each of the plants for the recovery of *iso*butane, butane, and propane fractions. Stearns-Roger Manufacturing Company built the original plants and is contractor for the new additions to the three plants. The Lockhart Oil Company cycling plant in the Agua Dulce field is being enlarged with *iso*butane and normal butane recovery equipment to process approximately 60,000,000 cu. ft. per day. Construction of the first plant and present additions is by Petroleum Engineering, Inc.

Refinery Process

Near Corpus Christi the Great Southern Corporation, under the direction of The Pontiac Refining Company and aided by the Defense Plant Corporation, is constructing a refinery containing an H.F. alkylation unit, catalytic dehydrogenation unit, and a Dubbs thermo reforming unit for processing the cuts from the four cycling plants in the Stratton and Agua Dulce fields. The refinery will handle the entire production of the cycling plants and accomplish maximum conversion of normal and *iso*butane into wartime products. No additional crude oil is required to be produced. *Iso*butane and normal butane are piped to the refinery separately from the gasoline, kerosine, and naphtha. A splitter separates the *iso* and normal butane. Normal butane enters the catalytic dehydrogenation unit for conversion to butylene and the *iso*butane goes to the alkylation unit for alkylate production. The H.F. alkylation process does not require disposal of spent acid, but is regenerated for further use; thus the process is an economical one. Debutanized distillate is de-*iso*pentanized and the *iso*pentane blended with alkylate and straight-run aviation base stock,

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This began with the original field test work in 1938 and has continued through the construction of the three projects with their present enlargements for butane extraction.

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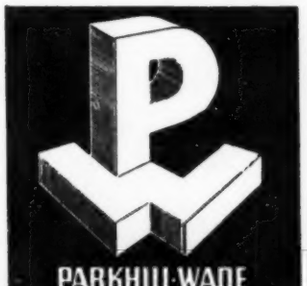

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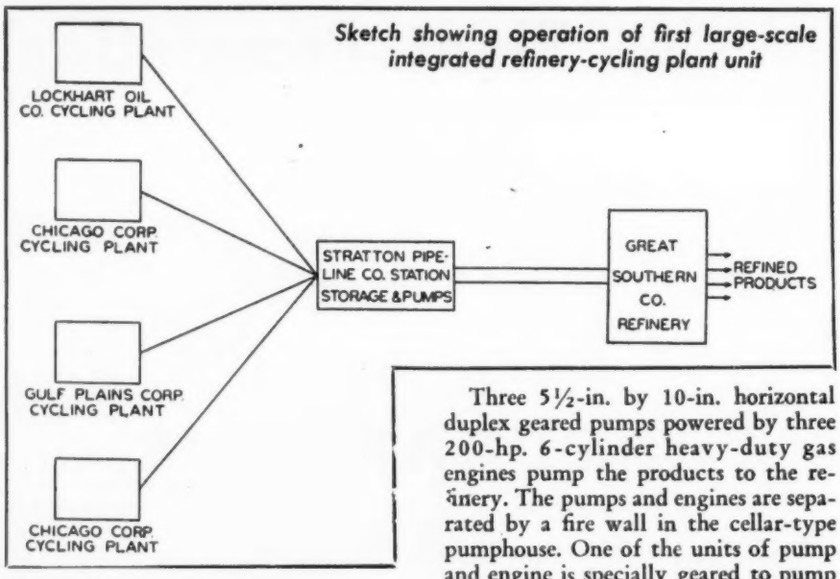

LOCKHART OIL CO. CYCLING PLANT
CHICAGO CORP. CYCLING PLANT
GULF PLAINS CORP. CYCLING PLANT
CHICAGO CORP. CYCLING PLANT
STRATTON PIPE-LINE CO. STATION STORAGE & PUMPS
GREAT SOUTHERN CO. REFINERY
REFINED PRODUCTS

Sketch showing operation of first large-scale integrated refinery-cycling plant unit

then leaded to produce 100-octane aviation gasoline. The remainder of the distillate is split in two parts: the light fractions are blending stock for 87-octane aviation gasoline, and the heavier fractions are charged to a Dubbs thermo reformer and cracked to produce motor fuel.

Pipe-Line Station

Production of the cycling plants is transported to the refinery from a tank farm and pumping station in the Stratton field by the Stratton Pipe Line Company. Storage capacity of the tank farm was increased by addition of 6 Hortonsphere tanks, each of 5000-bbl. capacity, and 75-lb. working pressure for storage of butane. There are five 20,000-bbl. gasoline tanks and three 5000-bbl. kerosine tanks.

Three 5½-in. by 10-in. horizontal duplex geared pumps powered by three 200-hp. 6-cylinder heavy-duty gas engines pump the products to the refinery. The pumps and engines are separated by a fire wall in the cellar-type pumphouse. One of the units of pump and engine is specially geared to pump butane through the 4-in. pipe line to the refinery at a pressure of about 570 lb. per sq. in. The second unit pumping gasoline and kerosine has an average pressure of 650 lb. per sq. in.; however, it can be lowered to 180 or increased to 1000 lb., if necessary. The station has a wide flexibility in pump speeds and pressures. A manifold system permits use of the third pump and engine unit as an auxiliary or standby unit and can be used to increase the capacity of the 4-in. butane line or the 6-in. main line transporting gasoline and kerosine.

An unusual feature of the station is the use of heat exchangers outside the pumphouse to cool the engines instead of the conventional radiator and fan mounted on the engine. Six 1½-in. heat exchangers and a 150-bbl. water-storage tank handle all cooling water for the engine jackets and intake and exhaust manifolds. A part of the outgoing product of the plant is by-passed through the heat exchangers, lowering the temperature of the cooling water. Two of the exchangers are tied into the 4-in. line and four into the 6-in.

In the event of broken lines, manifold connections, or leaks, the station can be shut down by master switches. About 20 ft. from the building the suction and discharge lines are equipped with block valves to shut off the product.

Cycling Plant Additions

Construction of additional units for the recovery of butane and propane fractions at the cycling plants is being rushed to completion; however, at the present time the Wardner and Sullivan plants are the only ones in operation. The Chicago Corporation plants are very nearly identical in capacity and operation. Additional equipment for the plants and changes to the existing equipment provide for the recovery of 86 percent butanes. Addition of the new equipment is designed to place the three plants on a par.

Approximate quantities of products from each of the three larger plants are as follows:

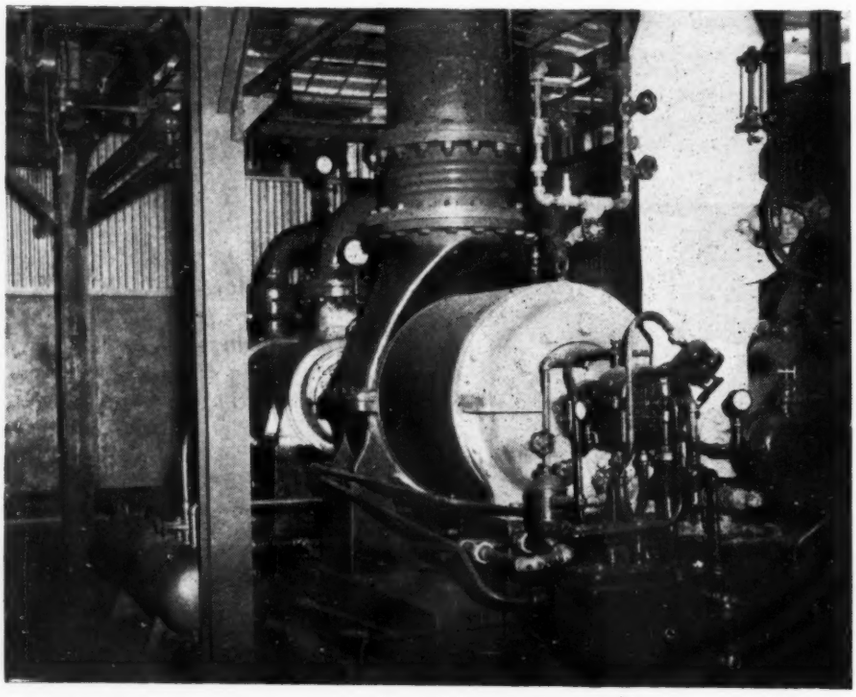
	Gal. per day
Butane free gasoline	108,000
Butanes	33,000
Kerosine	9,000
Total production per plant	150,000

This production from each of the three plants is based on processing a total of 125,000,000 cu. ft. per day. Absorber pressure for low pressure wells are about 1250 lb. per sq. in. and high pressure wells are processed in higher pressure absorbers. Gas is successfully processed in absorbers operating up to 2000 lb. per sq. in. Gas in the field has the following approximate composition:

	Mol. percent
Methane	91.63
Ethane	3.67
Propane	1.61
*Iso*butane	0.50
Normal butane	0.50
*Iso*pentane	0.28
Normal pentane	0.41
Hexanes plus	1.40

Description of Plant Flow

A dual gathering system supplies wet gas to the plant through 8-in lines for the high- and low-pressure absorption systems. Before entering the absorbers the gas passes through desalting scrubbers, and coolers, to lower the temperature from about 145°F. to 85°F. The residue gas from the absorbers enters the compressors at a temperature of about 90°F. The pressure-maintenance units return dry gas to the formation at a temperature of approximately 200°F. and a pressure of 3200 lb. Single-stage compression is all that is required to inject the gas into the high-pressure



1050-hp. steam turbine driving 9-stage centrifugal 1500-lb. lean oil pump at Wardner plant

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give users many advantages never before available

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The new "head" seal employing a solid ring and two split collars tightened with cap screws, is assembled easily with only an 8" crescent wrench. This construction avoids outboard stress on the split ring lock,—and tests with a solid copper gasket have proved it capable of holding more than 2000 pounds pressure for days, without trace of any "weeping."

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A fully descriptive engineering bulletin, complete with dimensions and other data of interest to every engineer and operating men sent gladly on request. No obligation. Send for Brown "Sectional Hairpin" bulletin today.

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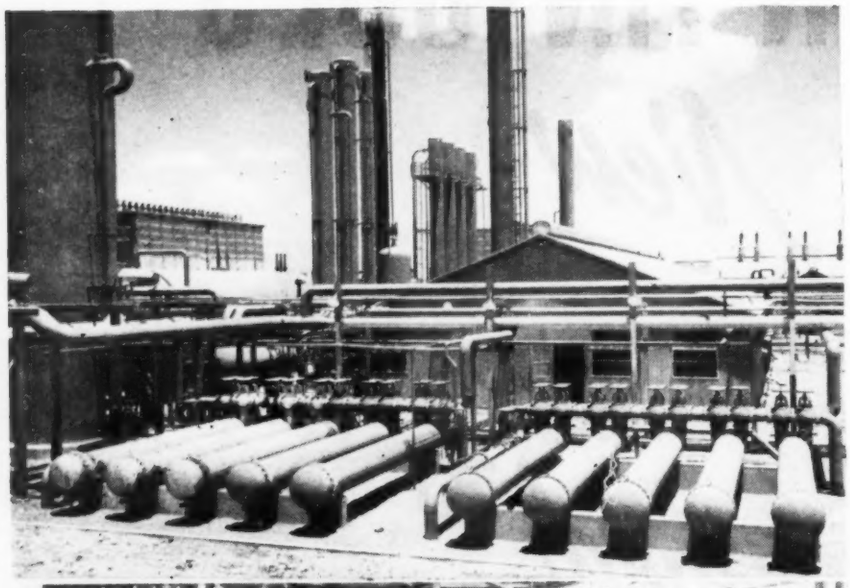
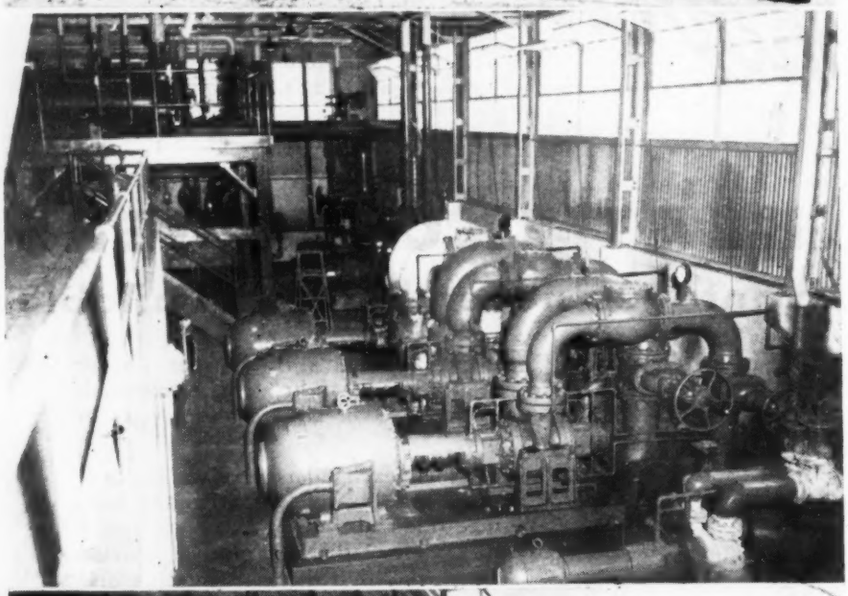
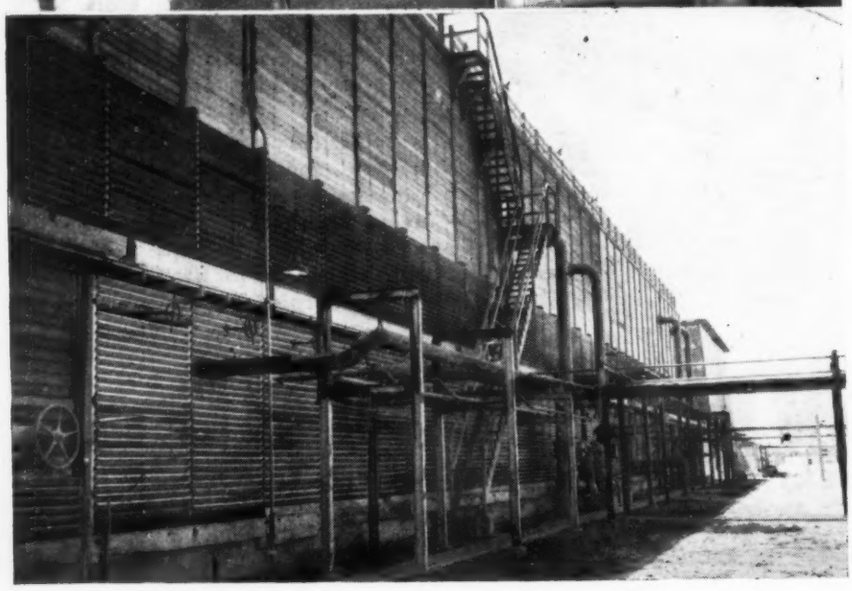
MANUFACTURERS OF INTEGRALLY BONDED FINTUBES AND FINTUBE HEAT EXCHANGERS

Top: Lean and rich oil heat exchangers in front of distillate pump house. Center: Low pressure lean and rich oil pumps, electric motor driven; left, steam turbine and condenser. Bottom: Induced-draft-type cooling tower







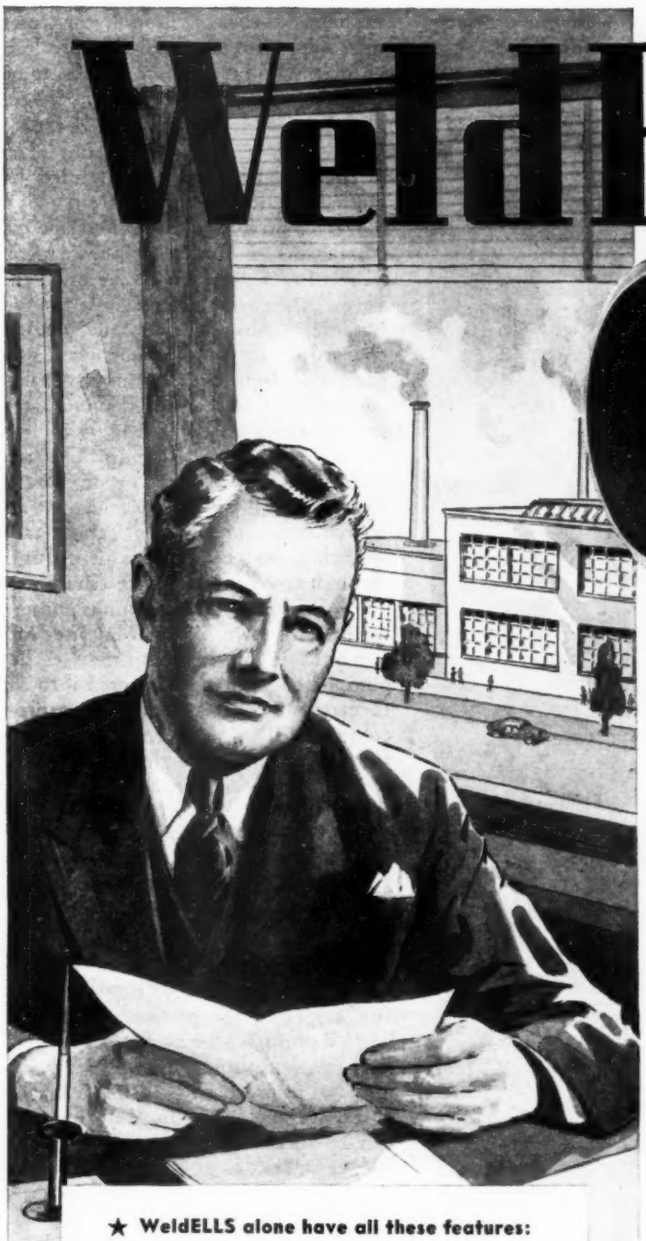
field due to the high absorption pressures. Rich oil leaves in one stream from the four absorbers and enters the high-pressure vent tank operated at 800-lb. gauge. Residue gas from this vent tank enters the high-pressure reabsorber. Rich oil from the bottom of the reabsorber merges with the rich oil from the vent tank and passes to the intermediate-pressure vent tank. Dry gas from the top of the reabsorber is used as high-pressure drilling fuel or, after passing through the stop tank, enters the suction of the recompressor to be boosted to the suction pressure of the pressure-maintenance engines.

From the intermediate-pressure vent tank rich oil passes to the intermediate reabsorber, operating at 200 lb. pressure. The oil from bottom of this reabsorber merges with oil from the intermediate vent tank and passes to the fat-oil surge tank. Dry gas from the top of the intermediate reabsorber passes through a stop tank and goes to the fuel system of the plant or to the suction of the high-pressure recompressor.

Gas flashing off the rich-oil surge tank, operating at 40 lb. gauge pressure. passes to the low-pressure reabsorber. Oil from rich-oil surge tank and oil from bottom of low-pressure reabsorber go to a vent tank, which operates at one lb. or 16 lb. abs. Residue gas from the low-pressure reabsorber goes into the low-pressure fuel system. After passing through a stop tank gas from the 16-lb. vent tank goes to the suction of a 16-lb. recompressor, which discharges back to the low-pressure reabsorber.

Rich oil from the 16-lb. vent tank goes to the suction of a centrifugal 125-hp. electric-motor-driven rich-oil pump and is delivered to a bank of heat exchangers to be heated by hot lean oil from the bottom of the kerosine distillate still, No. 2. The rich absorption oil then passes through the two Alcorn heaters and is heated to 550°F. Oil passes through 6-in. tubes in the heaters and then passes to the gasoline still where gasoline vapors are taken off overhead. The vapors pass through condensers into the raw feed tank. A portion of raw feed is pumped over the No. 1 still for reflux and the remainder is charged to the debutanizer column. Oil from the bottom of the No. 1 still (kerosine distillate and absorption oil) passes to the No. 2 still. When passing to the No. 2 still as much of the oil as is necessary to control the base temperature of the kerosine naphtha still is passed through the kerosine still reboiler. The kerosine and distillate mixture is taken off the top of No. 2 still and passes to storage or is charged to No. 3 still where the naphtha is taken off the top and kerosine off the bottom. Lean absorption oil is taken from the No. 2 still by the hot lean-oil pump,

WeldELLS have everything ★



"It's my job to find better ways—"

"A plant superintendent's tough job, as I see it, is to size up the facts and separate the something better from the so-called good enough. After all, there is only one *best* way to do a thing and it's my assignment to find it.

"Of course the difference between best and next best isn't so very great in some cases. But when it comes to welding fittings I think a cold appraisal will give a distinct edge to WeldELLS.*

"WeldELLS are basically sound from the start: Seamless—reinforced where stresses are greatest—engineered down to the last detail. Then, over on the practical side, they have everything it takes to speed up the job and cut costs. The clean machine tool bevels facilitate good welding and cut piping costs. Precision quarter-marks are a big help to the welder; and the permanent markings of size and weight on every WeldELL are nothing short of a must."

Yes, whether you are looking for safety, utility, convenience or economy—and who doesn't want them all?—you have in WeldELLS one of those rare products that offers you EVERYTHING!

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- **Seamless**—greater strength and uniformity.
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- **Selective reinforcement** —, provides uniform strength.
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- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

The list of Taylor Forge's contributions to the war effort only begins with WeldELLS. One of many examples is Taylor Corrugated Marine Furnaces, essential to many merchant ships and transports.

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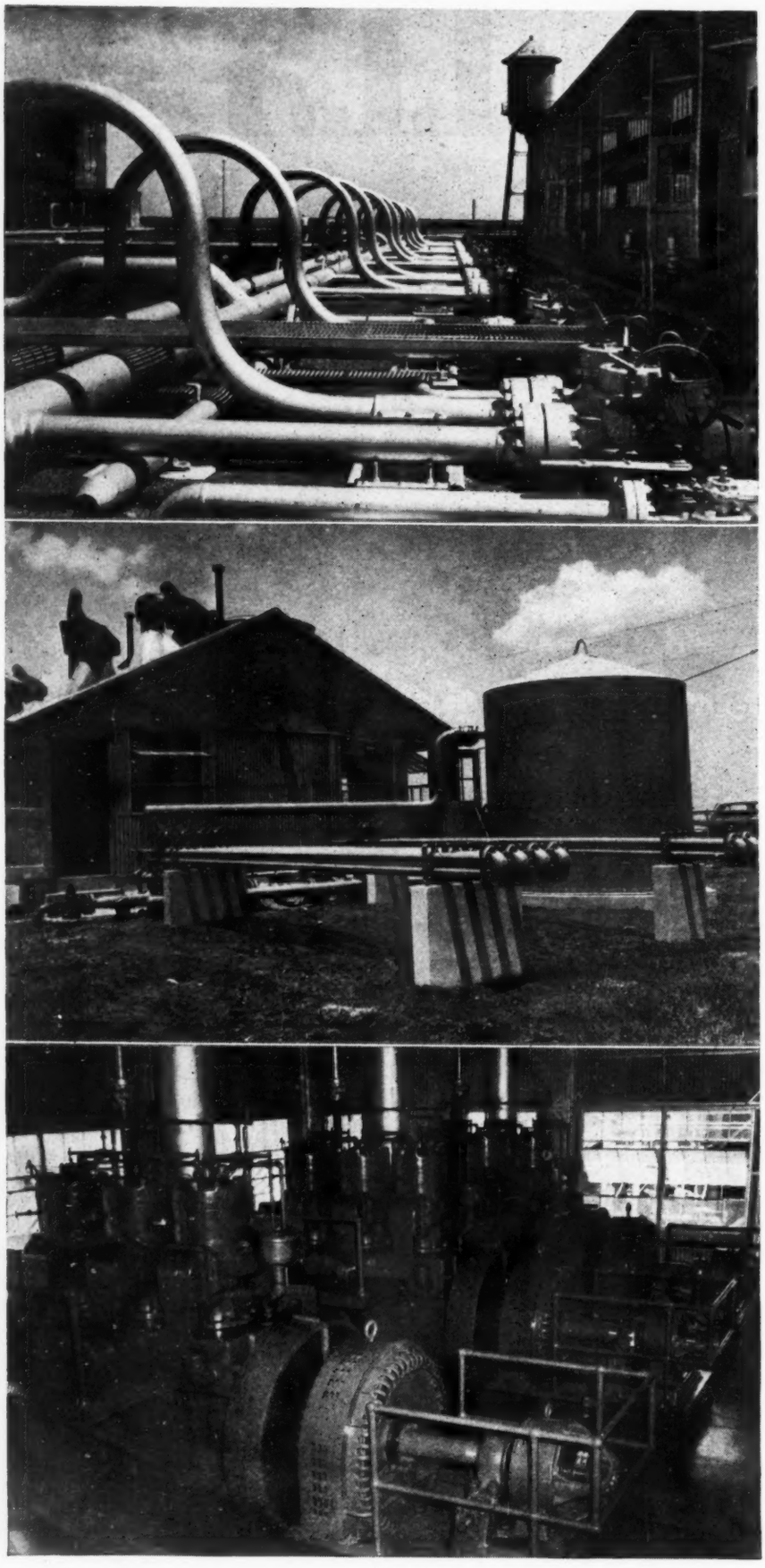
*WeldELLS and many other Taylor Forge products are produced in Byers Genuine Wrought Iron.

Top: Compressor discharge manifold at Coastal plant. Center: Stratton Pipe Line Company station heat exchangers for cooling jacket water with the products pumped. Bottom: Three of four 312 kva. generator units delivering 1186 kw.



which discharges it through the heat exchangers, thence through condensers into suction of the high-pressure lean-oil pumps and reabsorber pumps, to begin another cycle.

Gasoline from the raw-feed tank is charged to the 40-tray debutanizer. Bottom product of the debutanizer has a Reid vapor pressure of from 6.5 to 8.5. This product and the kerosine distillate goes to storage at the Stratton Pipe Line Company's Harlan Tank Farm. Overhead product of the debutanizer column (pentane free) is charged to the depropanizer where propane and lighter fractions are taken off overhead and returned under pressure to the formation by a high-volume, steam reciprocating pump. The bottoms of the depropanizer, a mixture of *iso*butane and normal butane, are delivered under pressure to a surge tank and then to the *iso*butane column through flow controllers. Overhead product of the *iso*butane column is pumped to the tank farm. Normal butane from the bottom of the column is either pumped to storage or injected into the formation. Bottoms of the depropanizer column will be pressured to the tank farm, and pumped to the Great Southern refinery near Corpus Christi when that plant is ready for operation.

At the Wardner plant three reabsorbers for processing gases from the vent tanks have been installed. The high-pressure reabsorber is 24-in. O.D. by 38-ft. net shell by 7/8-in. wall thickness. It has a 7-ft. skirt, 16 trays, and a working pressure of 937 lb. per sq. in. at 100°F. The high-pressure reabsorber lean-oil pump is a 14 by 4 by 12 forged-steel simplex plunger pump. An intermediate reabsorber is 36-in. O.D. by 40-ft. net shell by ½-in. wall thickness and 16 trays; working pressure is 305 lb. per sq. in. at 100°F. A horizontal simplex piston pattern pump 8 by 6 by 12 supplies lean oil to the intermediate-pressure reabsorber. The third or low-pressure reabsorber is the same size as the intermediate reabsorber, but is constructed with ¼-in. wall thickness. It has 16 trays and a working pressure of 150 lb. per sq. in. at 150°F. Lean oil is supplied to this reabsorber by a 6-in. single-stage, horizontal, double-suction, centrifugal pump driven by a 125-hp., 440-volt, 3510-r.p.m., explosion-proof electric motor.

The debutanizer column added is 60-in. O.D. by 85-ft. net shell by 11/16-in. wall thickness. This column has 40 trays, a 24-in. skirt and a working pressure of 248 lb. at 400°F. Reflux accumulator for the debutanizer is 60-in. O.D. by 18-ft. net shell by 11/16-in. wall thickness, and has a working pressure of 255 lb. per sq. in. at 100°F. Debutanizer reflux is pumped by a 10 by 10 by 18 simplex pump.

The existing debutanizer column was

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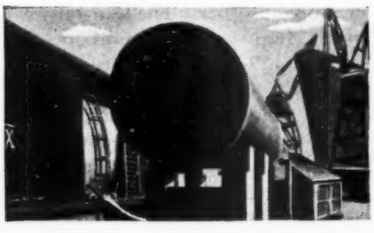
FLAME . . . as well as champagne christens ships. The last act that frees a ship from the ways is the cutting of steel bonds by oxy-acetylene flame. This swift cutting of steel typifies the way the oxy-acetylene flame is speeding the fabrication of ships, aircraft, locomotives, guns, shells, tanks, and hundreds of other vital articles made of metal.

All over America, this flame cuts time and gives to mass-production industries a means of manufacturing faster, better, and at lower cost. Since the white-hot oxy-acetylene flame cuts through metal as easily as a saw through wood, it makes steelworking as simple as carpentry! From the time steel is made . . . until it is finally cut up for scrap and sent back to the steel mills for a new lease on life . . . oxy-acetylene flames expedite its treating, cutting, and fabricating.

The oxy-acetylene flame is not new. Oxygen, acetylene, and many machines and techniques for treating, cutting, and fabricating metals have been made available to industry for years by THE LINDE AIR PRODUCTS COMPANY, a Unit of UCC. The present wide application of Linde's peacetime research and development . . . coupled with the great expansion of Linde's oxygen-producing and engineering facilities *before* the emergency arose . . . are contributing vitally to this country's mass output of the things it needs. These products and processes—plus new ones that are stemming from today's continuing research — are important among the mass-production tools that can be used in the future to bring you better cars, trucks, tractors, washing machines, refrigerators, and many other things for better living at lower cost.



LIQUID OXYGEN! The demand for oxygen today is great. Driox liquid oxygen has made it possible for mass-production industries to be supplied in bulk. Liquid oxygen—occupying only 1/862 of the volume of gaseous oxygen—is shipped in tank cars and tank trucks and converted to gaseous oxygen as needed.

SPEEDING QUALITY STEELS! Production line efficiency in removing surface blemishes from new steel became possible with the Lin-de-Surfacer scarfing machine. Huge mechanized batteries of oxy-acetylene flames "skin" hot steel . . . quickly and economically . . . resulting in higher yields of quality steel.

KNIVES THAT NEVER DULL! Oxy-acetylene flames held in mechanical arms trim and bevel steel plates for welding in a fraction of the time required by methods formerly used . . . cut in straight lines, circles, or in irregular patterns. The flames are also used to harden and soften metals and to prime them for painting.

MECHANIZED WELDING! "Unionmelt" electric welding automatically joins steel plates as much as 20 times faster than any similarly applicable method . . . and does it without noise, fuss, or sparks. This process complements the hand and mechanized methods of welding with the oxy-acetylene flame.

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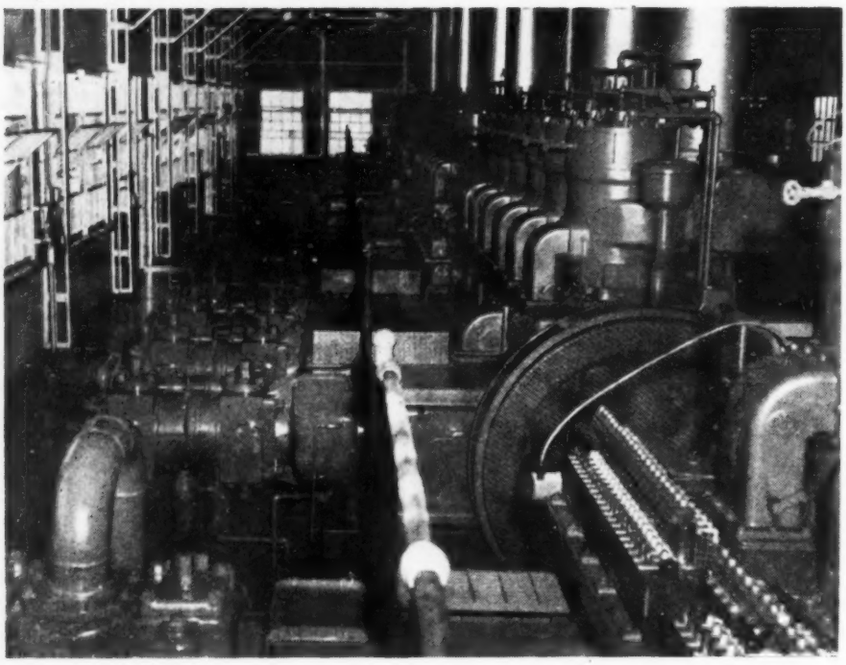

Compressor station at Wardner plant

converted to the depropanizer column by altering the heat exchanger and the method of control so that steam into the base and the amount of reflux and feed to the stabilizer are in set ratio. The charge is supplied by a high-volume simplex piston pattern 10 by 10 by 18 pump. Excess propane overhead from the depropanizer is pumped back into the formation at about 2200-lb. pressure with a 16 by 3½ by 12 simplex plunger discard pump.

The No. 2 lean-oil still is 90 in. by 35½ ft. by 5/16 in. It has 18 trays, and a working pressure of 75 lb. at 550°F. No. 2 still reflux accumulator is 60 in. by 10 ft. by ¼ in. Working pressure is 89 lb. and temperature 250°F. Reflux for the No. 2 still is handled by 2 ½-in. centrifugal pumps driven by two 5-hp. explosion-proof electric motors.

Three new boilers in addition to the existing boilers permit total delivery of 43,000 lb. of steam per hour. The boilers are 150 hp., 300-lb. working pressure, 100° superheat. Other equipment includes a de-aerator type boiler feedwater heater with a capacity to heat 53,700 lb. of water per hour.

Cooling Tower

Increased cooling capacity for the processing area required construction of a 15-bay extension on the north end and a 5-bay extension on the south end of the existing process cooling tower. The tower now contains 36 bays. Included were 17 additional redistributors. Installed on the induced-draft-type tower, in addition to ones already installed, are four 156-in., 2-bladed fans of airfoil design. They are driven by four 40-hp. splashproof electric motors. Two process cooling-tower water pumps, single-stage vertical centrifugal electric-motor-driven, were added for the new bays.

In the electric power house of the plant one new engine and a generator unit have been added. The natural gas engines are 3 cylinder in-line and rated to deliver 375 hp. each. Generators driven by the engines are a-c., 3 phase, 60 cycle, 480 volt, 312 kva. and have a rated speed of 360 r.p.m. Exciters for the generators are d-c., 7.5 kw., 125 volt. The total output of the four units now constituting the electric power source is 1186 kw.

Compressors

The new compressor added to the present eight is 600 hp., has six 14 by 14 power cylinders, angle type, and has the following compressor cylinders; one 6½-in. cast-steel double-acting, one 5⅜-in. cast-steel double-acting, one 3⅜-in. cast-steel, double-acting, and one 19-in cast-iron double-acting. Duties of the new unit as recompressor are as follows:

	Cu. ft. per day
Vent gases to formation	6,803,000
Gasoline dewatering tank vapors delivered to debutanizer column	571,000
Vapors from 16-lb. vent tank to low-pressure reabsorber	827,000

High-Pressure Absorption

Absorption pressures in the Wardner plant are believed to be the highest used in cycling plants. Two of the 4 absorbers operate at a pressure of 2000 lb. and the other 2 at 1600 lb. Total absorption oil pumped over the 4 absorbers is about 600 gal. per min. About 272 gal. per min. of the absorption oil goes over the low-pressure absorbers. The lean-oil supply for the high-pressure absorbers is delivered by a 9-stage, centrifugal pump driven by a 1050-hp. steam turbine with the following auxiliaries: a 1245-sq. ft. vacuum condenser complete with a single-stage ejector and after condenser, an 8-in. atmospheric relief valve, and copper expansion joint. There are also two 1½-in. centrifugal pumps with 3-hp. explosion-proof electric motors for the condenser. A side stream from the discharge of this pump is diverted to a hydropress pump, which boosts it to 2000 lb. for the 2000-lb. absorbers. The hydropress pump is a 15-in., 8-stage, vertical, double-case unit, direct-connected to a 125-hp. electric motor.

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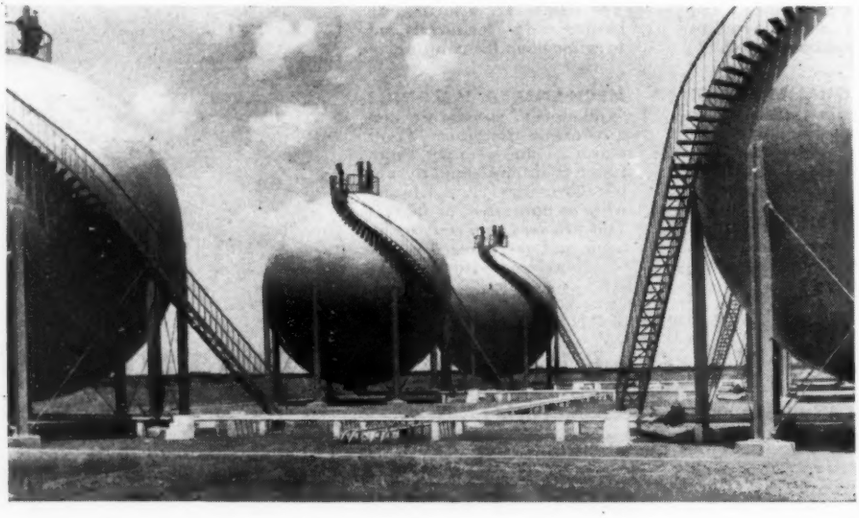


Hortonspheres for storage at Harlan tank farm of butane from the cycling plants before pumping to the refinery

Portable Pipe Line Aids North African Campaign

☆ Designed by Sidney S. Smith of Shell, line enabled petroleum products to keep pace with advancing machines of war

S. S. SMITH

WHEN World War II broke out in 1939, Sydney S. Smith, manager of products pipe line department for the Shell Oil Company, Inc., began thinking in terms of the petroleum transportation difficulties that an army would face in conducting a "blitz" war. The sheer weight of petroleum products in bulk represented one appalling problem and the exposure of oil-carrying trucks to air attack was another.

Smith, like most Americans, expected that sooner or later the United States would be embroiled in the war. So in his spare moments, more as a patriotic contribution than anything else, he put on paper a design for a portable pipe line in the belief that it might some day be of use to the United States.

When the plan was completed, he showed it to Norman J. McGaw, vice president in charge of transportation and supplies for Shell, who authorized an appropriation of $10,000 for portable pipe line experimentation in the Middle West.

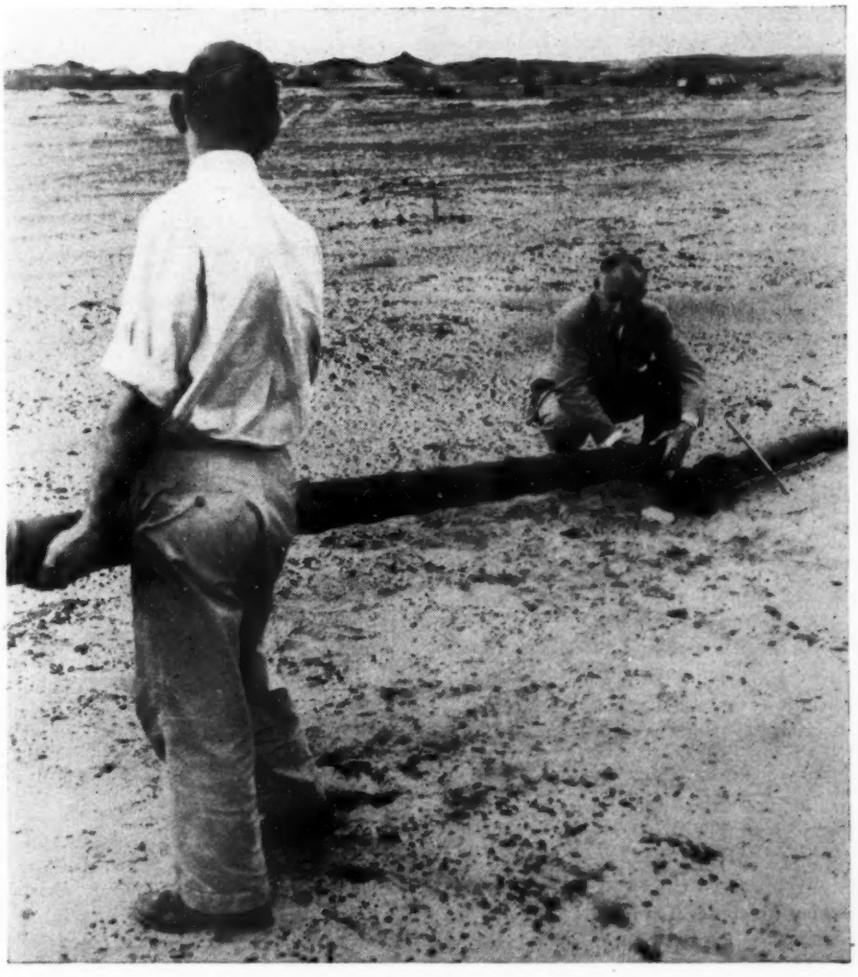
The plan had been completed but no tests had been made when in 1941 McGaw was visited by Mr. Bausfield, general manager of Shell's interests in South China, who made inquiries about the possibility of oil transportation over the Burma Road. He and McGaw discussed the hazards of bombing as well as poor surfacing, etc., which the Burma Road presented. McGaw said that a pipe line was the answer and called in Smith. The Smith plan was discussed in some detail and the matter was taken up with Alexander Fraser, president of Shell.

Fraser asked Smith for a complete report on the proposed portable pipe line. In five days a 33-page report illustrated by 18 prints was prepared and submitted to the Shell president.

Some of the features of the plan: 20-ft. sections of flexible pipe were to be used; pumping stations could be spaced at 20-mile intervals; all equipment, pipes, couplings, pumps, etc., could be transported on truck, in trailers, or on mule back; no trenches needed to be dug as the flexible pipe could follow the contours of the countryside; the flow could be stopped automatically at any point along the line; automatic pressure controls prevented trouble in the case of a break.

The plan was accepted by the Chinese Defense Supplies Corporation interests, and application was made for the required steel under lend-lease. Much of the pipe had been accumulated for transportation when United States Army authorities, studying the plan, reached a quick decision that it could become an important cog in plans for United States operations abroad.

John H. Hall, superintendent of Shell's East Line, under Smith, was



One man can handle a 20-ft. section of the light weight flexible pipe used in the portable petroleum pipe line, which helped make possible the Allied North African blitz. Sydney S. Smith of the Shell Oil Company, who conceived and designed the portable line, looks on approvingly as the 90-lb. section is carried into position

loaned to the Chinese Government to survey the possibilities of installing a pipe line on the Burma Road. The 1000 miles of pipe ordered for China were diverted to North Africa instead because in the meantime the Burma Road had been lost.

Tests were made by the Army in the Shenandoah Valley. During the tests a flood washed out a bridge over which a portable line had been slung. The strength of the pipe was indicated by the fact that the bridge remained suspended on the pipe line alone and the connection was not broken.

The only alteration in the original plan suggested by the Army was the reduction in size of the pumps to provide easier transportation. The result is that smaller pumps were spaced at 10- instead of 20-mile intervals.

Data on Line

The line has a capacity of 6000 bbl. (252,000 gal.) per day.

Pipe can be laid at the rate of 10 to 30 miles per day by unskilled or regular Army personnel.

Line can be operated under the supervision of a few trained operators.

No communication system is necessary because of the automatic cut-off and because only one kind of product is shipped through each line; a separate line is laid for each type of product in order to avoid dispatching complications under battle-front conditions.

The light weight flexible pipe is made in 20-ft. sections and each section, weighing only 90 lb., can be readily lifted and carried by one man. The pipe is 4 in. in diameter and spiral welded. The ends are grooved for flexible couplings.

The total weight per mile including pumping stations is approximately 13 tons. As the line is laid, gasoline can follow along immediately through the pipe. Maximum rate of filling the line is about 2.5 miles per hour.

The cost of the material (not including transportation or labor) is about $3000 per mile.

Gasoline-fueled engines operate the pumps; they were originally mounted on rubber-tired trailers for quick and easy movement, but in order to save gasoline and rubber the Army ruled that they were to be placed on skids instead.

Being flexible, the pipe line is not nearly so vulnerable to bombing as a rigid pipe line. Also, damage caused by bombing, sabotage, or other mishaps can be rectified quickly.

An individual pumping station, if put out of action, can be replaced in a few hours. During that interval the capacity of the lines is reduced only about 30 percent and returns to normal immediately upon the installation of the new unit.

The rapid advance of the Allied Forces in Sicily was possible only because petroleum products, through the use of portable pipe lines, were able to follow the advance.

At least four portable pipe lines were in use in North Africa during the recent campaign. They varied in length from 75 to more than 300 miles, and transported both gasoline and water in separate lines.

☆ ☆ ☆

P 111.39

Drilling Activity in South Dakota

SUCCESSFUL completion of a deep gas well in Potter County, South Dakota, in which a gas flow of 86,000 cu. ft. per day was obtained and which may result in the drilling of an oil test in the same area, shared interest in South Dakota oil development circles this summer and fall with the drilling of a wildcat oil test in Harding County.

The gas test, north of Whitlock's crossing in Potter County, east of the Missouri River, substantiated results of a survey of the area made by the state geological department in showing a structure of considerable size.

The gas flow of 86,000 cu. ft. a day is believed to be the largest flow of gas found so far in South Dakota. The gas was accompanied by a flow of water, about 1700 bbl. per day, through 1¼-in. tubing. The well was drilled to the Dakota sands.

The Harding County wildcat oil test, which has been closely watched this year by oil enthusiasts of the state, had reached a depth of 6466 ft. when a drilling accident forced temporary suspension of the work.

The well is being drilled by the Northern Ordnance Company of Minneapolis, under a "farm-out" agreement with the Carter Oil Company. The test, being drilled by a steam rotary rig, is planned for a depth of 7900 ft. to the Deadwood sand, according to notice of intention to drill filed with the state oil and gas commission by H. L. Scott, district representative of the Carter Oil Company.

The test is being drilled on lease blocks assembled in recent years by the Carter company, which recently sold a divided interest in several of its blocks to the Northern Ordnance Company.

Two other oil tests are being drilled in the state this year but progress on them has been slow.

The M. and M. Drilling Company of Marion, South Dakota, began drilling in southern Palatine township in Aurora County, east of the Missouri River, in August. Isaac P. Tieszen of Marion is president of the company.

Progress on the third South Dakota oil test in Fall River County, near Ardmore, is also reported to have been slow this summer and fall. The well is being drilled by what is described as the "Jesse Roote interests" of Denver. The A. S. Woodward Oil Company of Denver filed the notice of drilling with the state oil and gas commission. The well is being drilled with cable tools.

Drilling of a gas well at Pierre by the State of South Dakota also was begun this fall. The well is designed to supply gas for heating the statehouse. It will supplement a gas well that was drilled in Pierre in 1910 and which has been in production since.

South Dakota, together with its sister state of North Dakota, has been the scene of extensive leasing operations during the last four years. Several million acres of land are now under lease in the two states.

Heavy leasing of federally owned acreage in Harding County, near the Northern Ordnance test well, has been reported this year, with recent applications for leases being filed by A. I. Levorsen, Tulsa geologist, and his partner, Fred Moser, and by Robert G. Hipple of Pierre, South Dakota.

Other areas in South Dakota in which recent leasing activity has been noted include Fall River County, in the extreme southwestern corner of the state, in which the Amerada Petroleum Corporation has been active; Stanley and Hughes counties in central South Dakota, and White River-Wood area of Mellette County, southwest of Pierre. Interest has also been shown by major oil companies in southern Jones County, north of White River.

New leasing terms have been established this fall by the South Dakota rural credit board, which has many thousands of acres of land under lease in the state. New leases will be at the rate of 10 cents an acre for the first five years and 25 cents an acre for the next five years, Director Millard G. Scott has announced. Formerly the charges were 10 cents for the first two years and 10 cents a year for the remaining eight years. The new scale conforms to that of the South Dakota school and public lands leases. Both types of leases provide for one-eighth royalty to the state.

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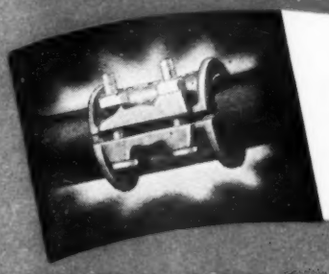

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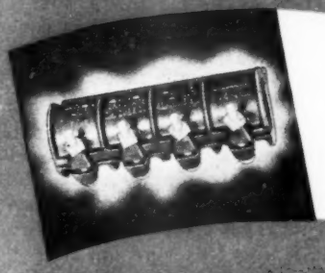

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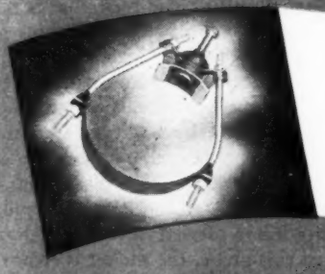

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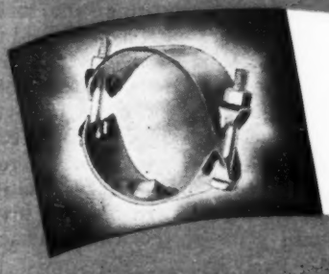
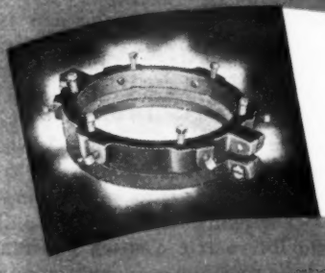
VENTED PLUG CLAMP

For stopping leaks in extremely high-pressure pipe lines—safely. No chance of injury or damage.



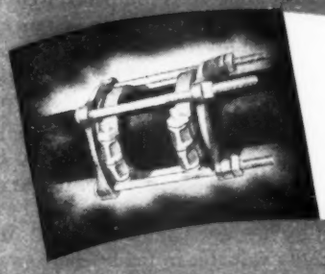
SKINNER-SEAL
PRESSED STEEL ECONOMY CLAMP

For repairing badly pitted and corroded pipe lines at minimum cost. A strong, dependable clamp.



SKINNER-SEAL
PIPE JOINT CLAMP

For stopping leaks at joints where pipe is screwed into a fitting. Without shutdown. Absolutely permanent.



SKINNER-SEAL
COLLAR LEAK CLAMP

For stopping every type of collar leak, regardless of kind of collar or condition of line. Extremely rugged construction.

6 WAYS TO SAVE PIPE

AND MAKE LASTING REPAIRS, TOO!

Right now, with the critical shortage of pipe, the SKINNER-SEAL method of repairing pipe leaks is invaluable. Saves pipe, saves labor, saves time. Skinner offers a clamp for every leak. Write for complete 40-page catalog—fully illustrated.

M. B. SKINNER CO.
Established 1898
SOUTH BEND, INDIANA, U.S.A.

Rope Socket Design Effects Economy

☆ **Substantial saving in man hours revealed by time study**

by S. P. King, Production Superintendent,
Trinidad Consolidated Oilfields, Ltd., Fyzabad, Trinidad, B.W.I.

TIME studies utilized to investigate the possibilities of reducing operating costs are often instrumental in unearthing hidden values in small items of equipment. It is essential, therefore, in the breakdown of job times, that no item be overlooked no matter how small. A survey of this type, investigating possible sources of time economy in well servicing, found a substantial saving in the smallest item analyzed, the rope socket. The breakdown of the individual jobs of well servicing revealed nothing more than satisfactory work on the part of the crews, and rated performance of the well pulling units. Thus no savings were evident in changes of equipment or routine. An analysis, however, of the between-the-jobs time revealed a possible saving of from 75 to 100 man hours per month merely by adopting a newly designed rope socket.

The saving in man hours was commensurate with the number of swabbing or tubing bailing jobs. Each of the latter required a rope socket to be babbitted onto the end of the line. Upon completion of this work, it was then necessary to cut off 2 or 3 ft. of line with the rope socket before rigging up for a bailing or rod and/or tubing job. If the winch was then required to swab a well, the rope socket had to be cleared of old line and babbitt and then rebabbitted onto the line. Thus every swabbing or tubing bailing job meant 1 to 2 crew hours' work on the rope socket. The adoption of a new type of rope socket that eliminated continual rebabbitting, abolished fishing jobs resulting from poor babbitting, and effected a considerable saving in wire line, made a saving in man hours possible.

Utilizing the new type socket eliminates rebabbitting entirely except in cases where the wire line fails or becomes dangerously worn. Once the line has been babbitted, it can be quickly attached to traveling blocks, bailer, swab, well coring equipment, well surveying equipment, etc. The average one and one-half crew hours' charged to changing over from bailing to swabbing or vice versa are eliminated. The babbitted end of the line can pass over the crown block and need not be cut off. The socket is simplicity itself, consisting of only 6 parts and requiring no special tools. It can be efficiently handled by semi-skilled labor.

The advantages of this type of socket can be clearly illustrated by following it through a routine cycle. A good crew

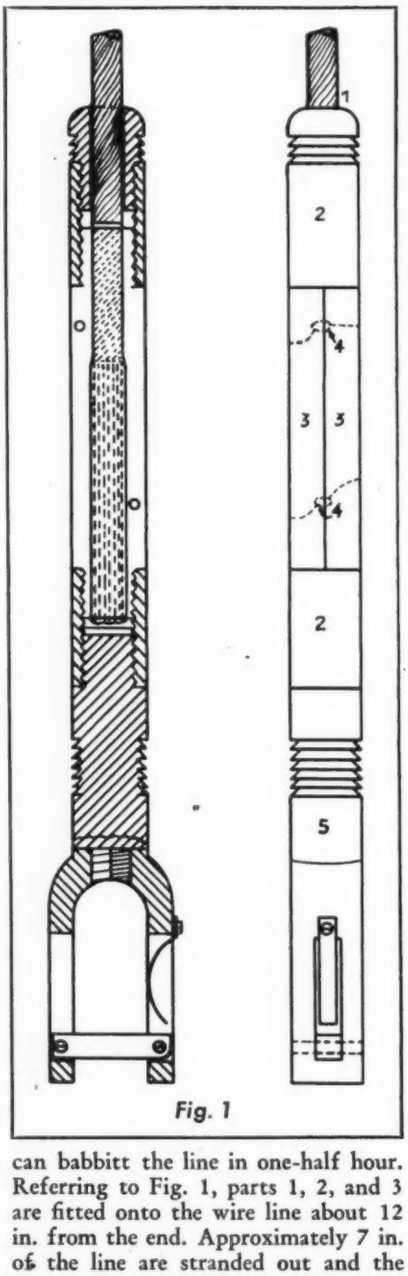


Fig. 1

can babbitt the line in one-half hour. Referring to Fig. 1, parts 1, 2, and 3 are fitted onto the wire line about 12 in. from the end. Approximately 7 in. of the line are stranded out and the hemp core removed. Half of the stranded ends are then "tucked back" and the stranded end of the line is pulled back into the split socket. Dowel pins, fitting corresponding holes (part 4), facilitate the exact alignment of the halves on the babbitted end of the line. Parts 1, 2, and 3 (attached to the line) are then heated and liquid babbitt is poured into the bottom end. When the split socket is cooled off, it is then detached from the wire line and if the babbitted end of the wire line is satisfactory, the well servicing machine proceeds to the well. When the traveling blocks have been strung, the socket is again attached to the babbitted end of the wire line, the bailing attachment (part 5) is screwed into the bottom collar, latched to the clevis on the traveling blocks, and the rod and/or tubing job is carried out. Having completed this phase, the socket is removed, the blocks are unstrung, the socket made up, latched onto the bail, and the well bailed. If the well servicing machine then moves to a swabbing job, the latch-jack and socket are removed, the oil-saver is stripped over the babbitted end of the wire line, the rope socket made up, and the sinker bars and swab assembly screwed into the lower collar in place of the bailing attachment.

For all its simplicity, this new type of rope socket possesses long wearing life. The long collars holding the split socket have 12 threads to the inch with a ⅜ in. taper. The danger of backing off in the hole is very remote. Wells in the writer's area have been bailed continuously for days with no loosening of the socket joints. One operator pulled 40,000 lb. to free a stuck bailer and found the rope socket in perfect condition afterward. In another instance, a new ⅝ in. line was parted attempting to free a stuck swab and the rope socket was found to be uninjured.

Many operators in Trinidad now use this type of rope socket and it has functioned very successfully. It was designed by Connor T. O'Connor and patented by him on August 11, 1942. It is especially valuable in fields where swabbing and bailing inside of 2 in. tubing constitutes a fair proportion of well servicing work. ——— ☆ ☆ ☆ ———

Baash-Ross News

BAASH-ROSS TOOL COMPANY · LOS ANGELES · HOUSTON · NEW YORK

PETROLEUM ENGINEER EDITION

Another BAASH-ROSS *Advancement*

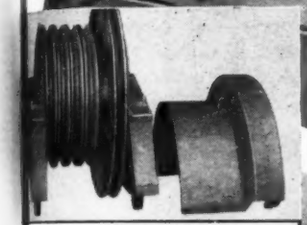


Fig. 1*. Above Block with cover removed showing offset arrangement of sheave for outside fast line.

Fig. 2*. Straight-in-line Block for rigs with fast line inside.

A UNITIZED CROWN BLOCK FOR PORTABLE RIGS!

Simplifies line reaving—

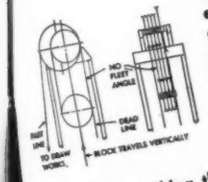
Eliminates "fleet angle"—

Assures vertical travel of blocks

WITH the steadily increasing emphasis on portable rig operations, the Baash-Ross organization, working in close conjunction with oil company engineers, has developed a new type of Crown Block for portable rigs . . . a Crown Block that embodies the most advanced developments in the field and offers unique advantages found in no other similar unit. It is rugged, extremely compact, and is so designed that simple over-and-over reaving is employed. This eliminates cross-over of the lines and insures the traveling blocks rising and falling in a straight line without drift or "fleet angle"—a vital advantage in the cramped quarters of portable masts!

Check over these features...

STRAIGHT-IN-LINE ASSEMBLY



In contrast to conventional portable crowns, the sheaves in the Baash-Ross Block are mounted "in line" so that all drilling lines are parallel and in the same plane as they feed to and from the block. Note in the diagram at left how this eliminates twisting and drifting of the traveling blocks as they move up and down the derrick. This same feature also eliminates "pull-back" from the center of the derrick, assuring true vertical block travel without risk of striking the inside bracing of rig or finger board—a particularly valuable safeguard in all portable rig operations. This feature also greatly speeds up pipe handling. The derrick man does not have to "fight" twisting, drifting blocks when handling the pipe, and the floor men do not have to work against the off-center swinging of the pipe as the blocks are raised and lowered.

DIRECT CARRY-OVER OF FAST LINE

The Baash-Ross Crown is available in two basic styles*—one a straight-in-line type for rigs where the fast line comes down the inside of the derrick (fig. 2). . . . and the other a type particularly engineered for rigs where the fast line leads to the draw-works outside the rig (fig. 1). In this latter type, the fast line sheave is larger in diameter than the others and is mounted eccentrically with respect to the bearing shaft for the other sheaves. This enables the larger sheave to be tangent to the other sheaves on the inside of the rig, but sufficiently offset on the back side to carry the fast line completely clear of the outside of the derrick. Thus, it provides the same in-line advantages, yet carries the fast line outside the derrick without extra sheaves or complicated reaving. And because the fast line sheave is larger, its rotational speed is substantially reduced instead of increased as with conventional auxiliary sheave arrangements!

UNIT-BUILT CONSTRUCTION

To assure simplicity of installation and rigid sheave alignment, the Block is built as a unit, and can be installed and removed as a unit. In addition, spacer plates are eliminated and, by direct abutment of the stationary inner bearing races, all sheaves are spaced the same as the traveling block sheaves. This eliminates "fan out" of lines, reduces line wear, and prevents side motion of blocks. Heavy duty double row tapered roller bearings carry the load and each bearing is lubricated through individual grease ducts drilled through the center pin. A grease seal conserves lubricant and prevents grit and moisture from reaching the bearings.

WIDE RANGE OF SIZES

The Baash-Ross Unitized Crown Block has a capacity of 35 tons per sheave and is available in any number of sheaves desired. Thus, a wide range of sizes is available to meet the requirements of any portable rig operations. The sheaves are of alloy steel, flame hardened, and grooved for 1" to 1¼" lines, as specified.

RUNNING MATE to the Baash-Ross Unitized Crown Block is the Baash-Ross Unitized Block . . . a traveling block that combines block and link adapter (or hook) in one compact, space saving, easy-to-handle unit. Adds extra feet of working height to portable rigs, enabling pipe to be run in and out of hole faster, speeding up floor operations, reducing risk of running into crown and often permitting the use of longer pipe lengths. *Write for details on this advancement!*

*** The two types of Baash-Ross Unitized Crown Blocks illustrated above are only typical of the wide range of designs available to meet the special requirements of *any* portable drilling or service rig. Write our engineering department for full particulars on a Unitized Crown to meet *your* requirements!**

Canada's Synthetic Rubber Program

PETROLEUM ENGINEER Exclusive Feature

☆ Cooperation of United States and Canada speeds development of wartime rubber plants to alleviate shortage of critical material

by C. C. Pryor
Associate Editor

NORMAL peacetime consumption of rubber in Canada ranged between 30,000 and 35,000 tons per year. With the attack on Pearl Harbor Canada became concerned about its supply of rubber. At the time, fairly large stocks of natural rubber were on hand and even larger stocks on order. These stocks on order included 21,000 tons in Singapore and Penang. Eventually, practically all of this order reached Canada.

Canada was forced to take immediate stock of the situation, and to play a useful part in the war it was obviously necessary to adopt means of finding a substitute for natural rubber. The United States was facing the same problem. Working cooperatively, the two countries pooled stocks of rubber and information to meet the approaching crisis when existing stocks of natural rubber would be exhausted.

U. S. Patent Pooling

Canada was thus given the full benefit of the patent pooling agreement made by the Rubber Reserve Company with the companies and industries in the United States. This arrangement aided the government in overcoming the intricate problems that arose out of the manufacture of synthetic rubber on the large scale required for the war program of the Allied Nations. Combined judgment of the two countries decided upon petroleum as a base for butadiene as the cheapest and most satisfactory. At the time this decision was made most of the program for production of buna S synthetic rubber in the United States was based on petroleum for the production of butadiene. Research and development work in the processes involved in the production of butadiene from a petroleum base had been made in the United States, and Canada was offered the use of all information obtained on the same basis as similar projects in the United States. To avoid excessive delay in starting the program, as part of the overall North American program and to obtain the necessary priority ratings for equipment and materials that were not procurable from Canadian sources, it was considered advisable to use existing plans, designs, drawings, and specifications, prepared and developed by the Rubber Reserve Company. About 25 percent of the materials and equipment required was not obtainable from Canadian sources, but through correlation of the two programs, Canada was able to obtain much specially designed equipment by merely placing duplicate orders with the fabricators. As a matter of fact, the principal Canadian plants are duplicates of plants in the United States.

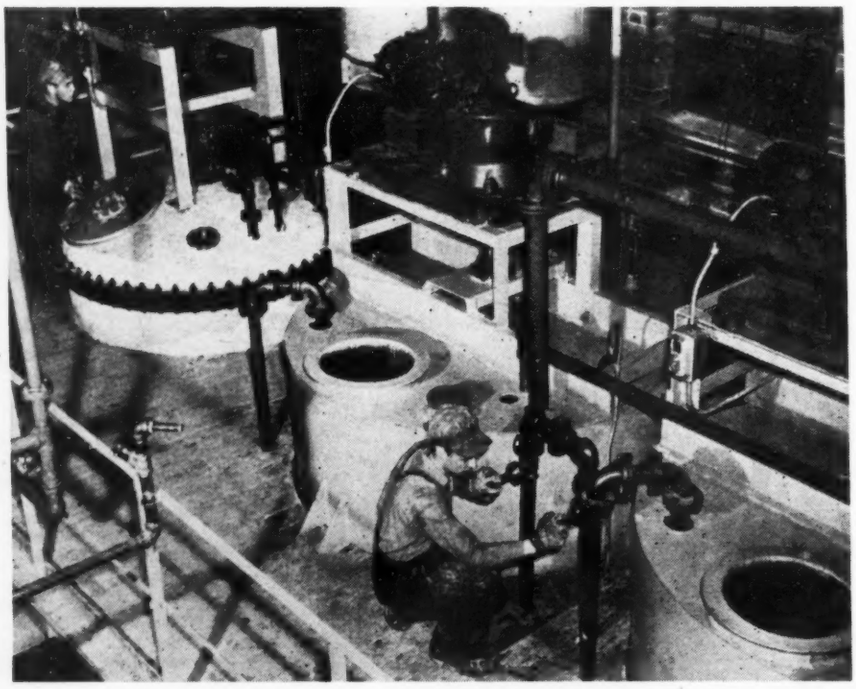
Survey of Facilities

Main decision made in the Canadian synthetic rubber program was the erection of plants capable of producing 34,000 long tons of buna S per year and the two basic materials required for its manufacture — butadiene and styrene. The results of a survey from which the petroleum base synthetic rubber decision was made are as follows:

1. The total facilities for the production of alcohol in Canada would produce less than two-thirds of the alcohol required to provide the butadiene equivalent of the rubber required.

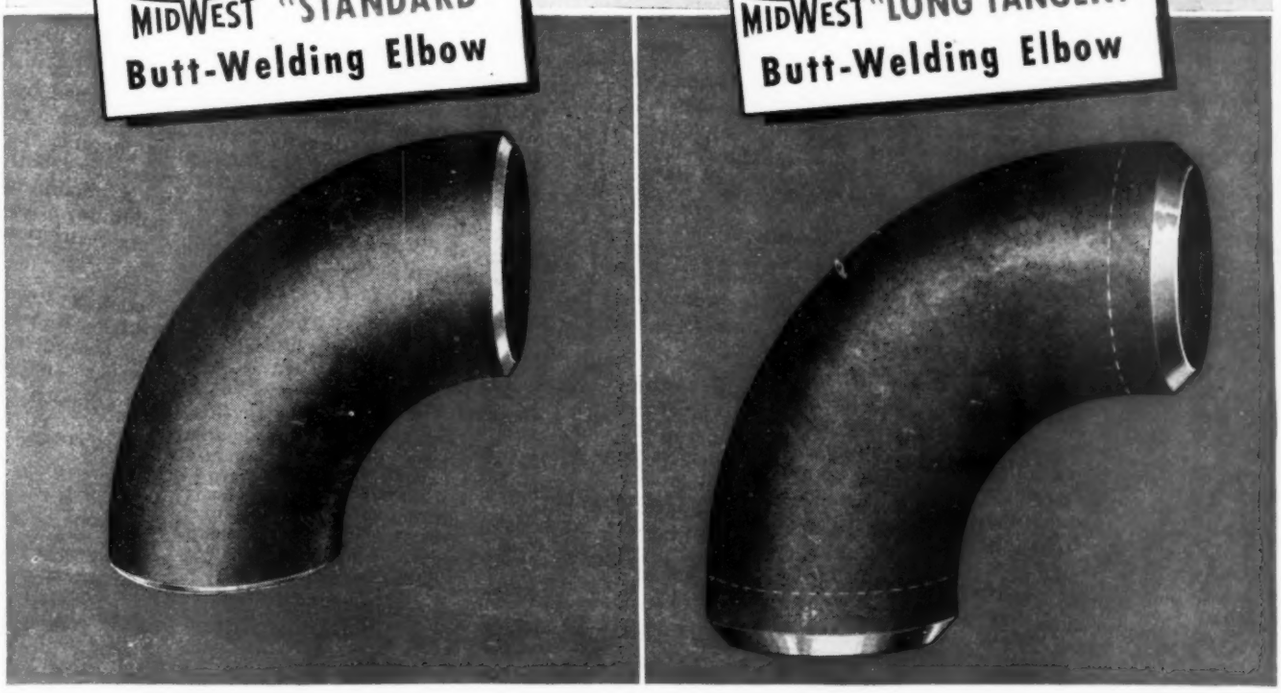
2. Combined cost of building additional facilities for the production of alcohol and the cost of building plants for the manufacture of butadiene from alcohol were greater than the costs of

(Continued on Page 142)



Thiokol plant. Operator at left is at reactor tank where polysulphide and organic chemicals are reacted. Storage tanks are at right

Only MIDWEST OFFERS YOU THIS CHOICE



The difference between the two types of welding elbows shown above is in their dimensions. The "American Standard" elbow has a center-to-end dimension equal to one and one-half times the nominal pipe size. The Midwest "Long Tangent" elbow has tangents (straight ends) equal to one-fourth of the nominal pipe size; the center-to-end dimension is one and three-quarters times the nominal pipe size. Important among the advantages of the long tangents are: (1) pipe and fitting more quickly and accurately lined up, (2) weld removed from point of maximum bending stress, (3) less pipe required, (4) short nipple and extra circumferential weld frequently eliminated, (5) slip-on welding flanges easily used, etc. There is no increase in price for Midwest "Long Tangent" Welding Elbows.

Both types of elbows have all other advantages that result from the unique Midwest manufacturing process: final working of metal in compression (which means exceptional dimensional accuracy and uniformity), stress relieving, exact included angle, true circular cross-section and uniform wall thickness. For all the facts about Midwest Welding Fittings, ask for Bulletin WF-41.

MIDWEST PIPING & SUPPLY CO., INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Bldg.

A LESSON IN WATER COOLING

LESSON 7 OF A SERIES

INDUCED DRAFT COOLING TOWERS OF HORIZONTAL DESIGN

Any product which consistently leads its field is generally the one which offers the most practical combination of all desirable features at least cost. In the case of mechanical apparatus, careful *designing* is necessary to coordinate the theoretical with the physical factors; and *users' experience* will invariably point out the design which does this best. Note the greater use of *horizontal* steam condensers. Also note the success of heaters, coolers, boilers and other heat-transfer apparatus that employ the cross-flow principle.

The horizontal type cooling tower employing horizontal air-flow is another example. It has won and held first place in its field through the past five years due to the simplicity and soundness of its basic design plus the general excellence of its physical characteristics.

Increasing the efficiency of evaporative water cooling equipment is a matter of accelerating the effective rate of heat transfer. Observe how the design of a horizontal type cooling tower accomplishes this by means of *perfected air-water flow.*

AIR FLOW

AIR VELOCITY: The uniform construction, both horizontally and vertically, of the air inlet louvers, the internal filling and the drift eliminators permits an even, straight-line air flow of uniform velocity for the *full travel* through the cooling chamber.

The fan suction chamber and drift eliminator design make possible the complete, equalized control of air velocity over the entire breadth and height of the cooling chamber.

AIR QUANTITIES: Greater air quantities with least draft loss are possible in horizontal cooling towers since the design permits (a) large and ample air passage through inlet louvers (b) large and ample air passage through the filling (c) large and ample air passage through drift eliminators (d) elimination of obstructions to air flow, such as internal systems for water distribution and baffles and filling laths set broadside to the air flow, and (e) elimination of air turbulence in general.

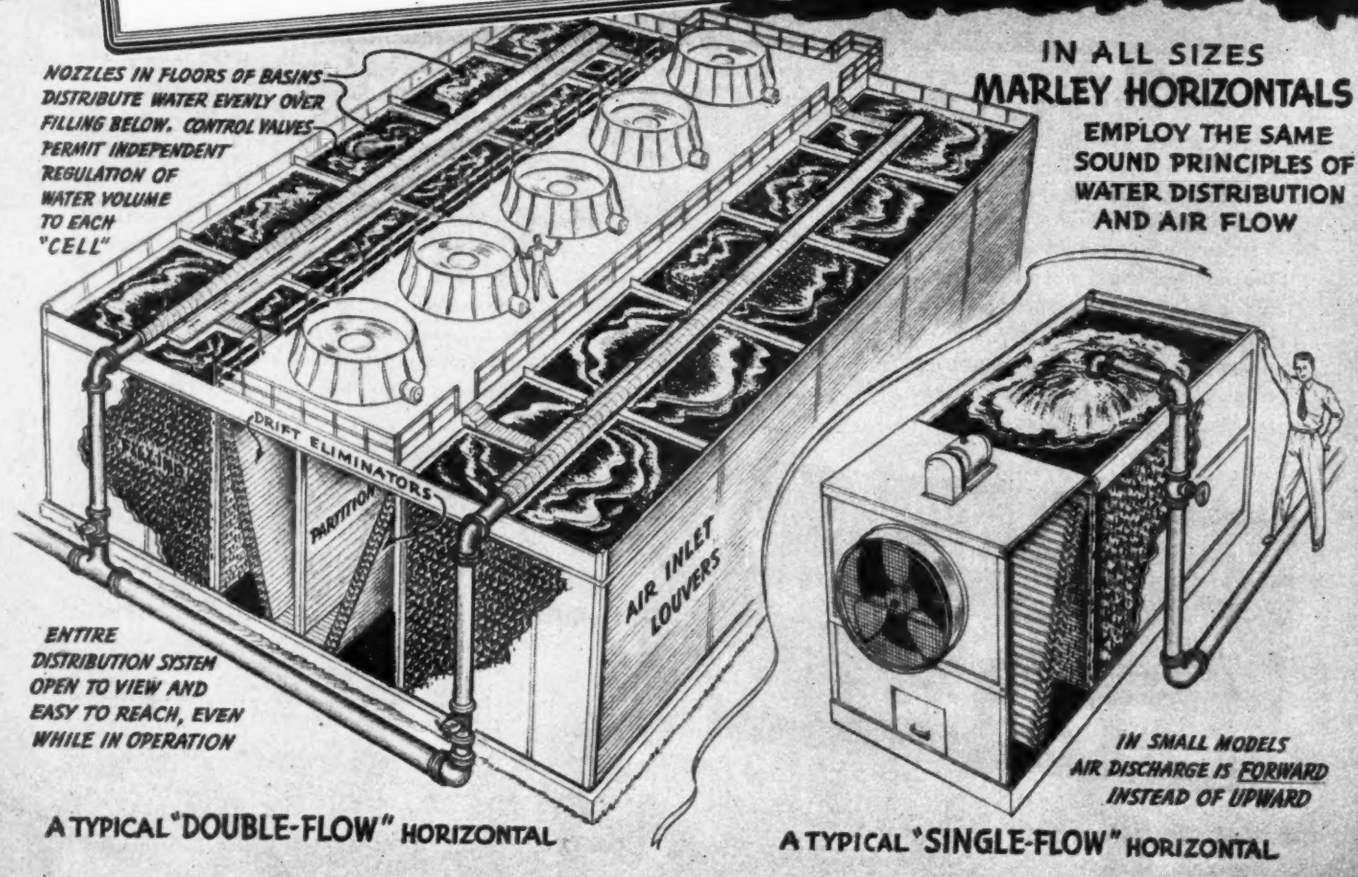
WATER FLOW

WATER DISTRIBUTION: Complete and uniform distribution of water over the entire cooling chamber is accomplished by evenly spaced nozzles located in the floor of the overhead water distribution basin. This uniformity of water coverage remains constant from top to bottom of the filling.

WATER SURFACE EXPOSURE: Initial break-up of water into fine droplets is accomplished by a diffusion deck directly beneath the discharge nozzles. On down through the cooling chamber the filling of staggered laths, on close centers both vertically and horizontally, provides a maximum of break-up and splash surface, a maximum effective wetted surface and minimum air restriction.

Not only does the horizontal cooling tower design achieve a maximum effective heat transfer rate by optimum air-water flow but it also incorporates many other noteable advantages such as

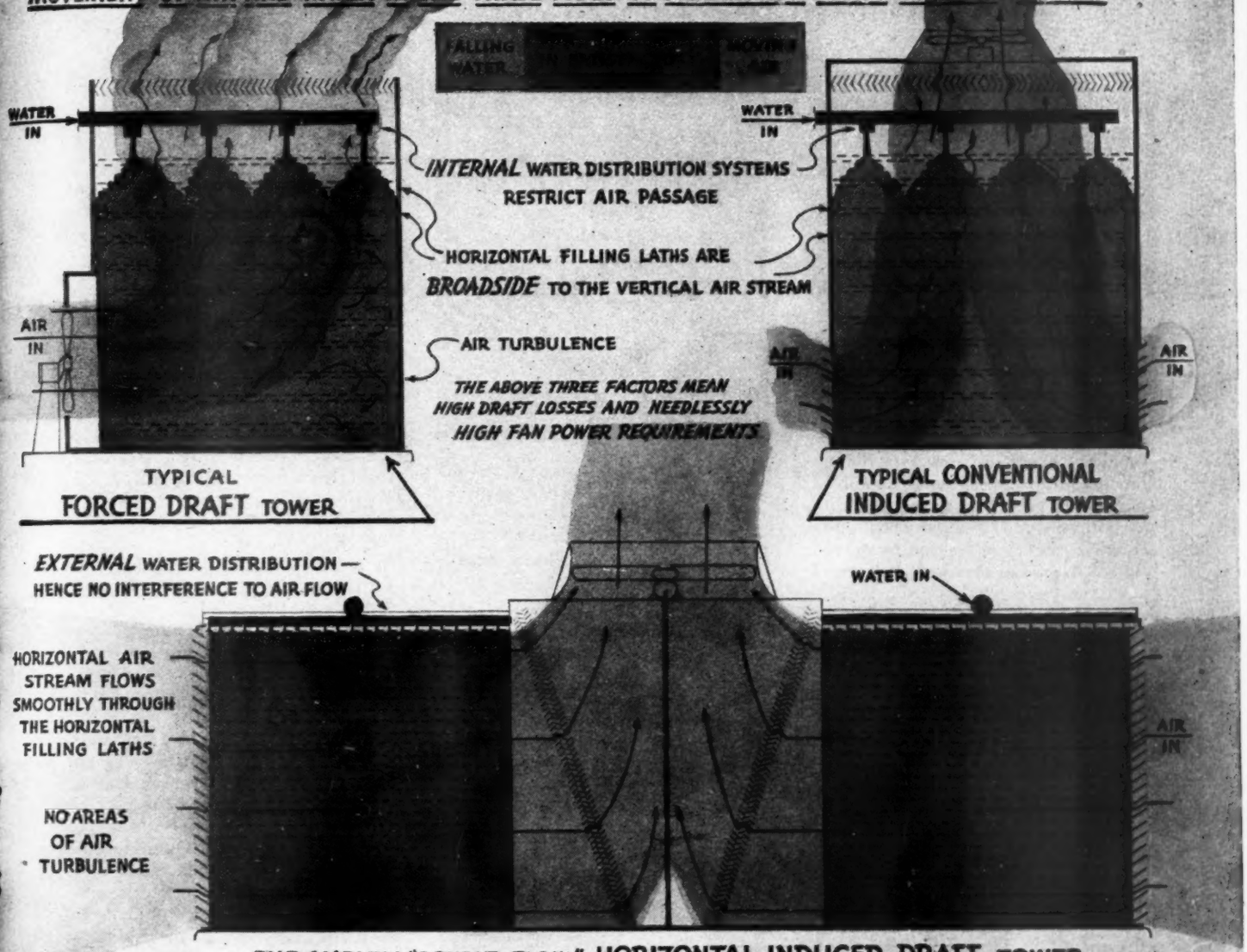
WATER DISTRIBUTION SYSTEM ENTIRELY EXTERNAL
PUMPING HEADS EXTREMELY LOW
BALANCED STRUCTURAL DESIGN, SIMPLE AND RUGGED
ALL PARTS READILY ACCESSIBLE
UNUSUAL OPERATING FLEXIBILITY
POSITIVE DRIFT ELIMINATION
APPEARANCE PLEASINGLY NEAT AND MODERN


NOZZLES IN FLOORS OF BASINS DISTRIBUTE WATER EVENLY OVER FILLING BELOW. CONTROL VALVES PERMIT INDEPENDENT REGULATION OF WATER VOLUME TO EACH "CELL"
DRIFT ELIMINATORS
PARTITION
AIR INLET LOUVERS
ENTIRE DISTRIBUTION SYSTEM OPEN TO VIEW AND EASY TO REACH, EVEN WHILE IN OPERATION
IN ALL SIZES
MARLEY HORIZONTALS
EMPLOY THE SAME SOUND PRINCIPLES OF WATER DISTRIBUTION AND AIR FLOW
IN SMALL MODELS AIR DISCHARGE IS FORWARD INSTEAD OF UPWARD

A TYPICAL "DOUBLE-FLOW" HORIZONTAL

A TYPICAL "SINGLE-FLOW" HORIZONTAL

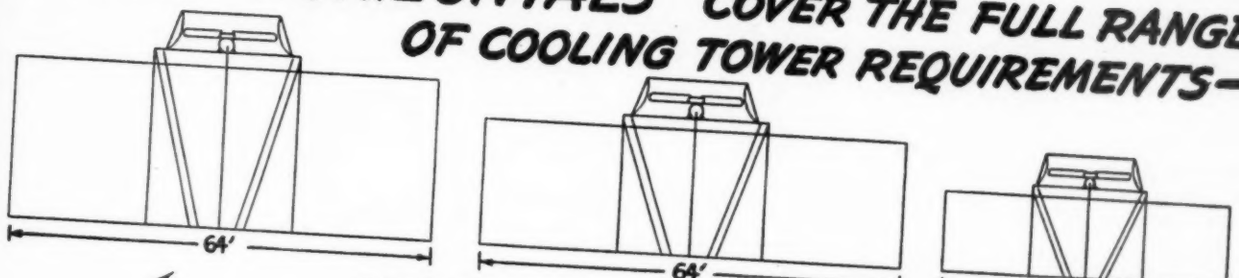
MOVEMENT OF AIR AND WATER IN THE THREE TYPES OF MECHANICAL DRAFT COOLING TOWERS


FALLING WATER
MOVING AIR
WATER IN
WATER IN
INTERNAL WATER DISTRIBUTION SYSTEMS RESTRICT AIR PASSAGE
HORIZONTAL FILLING LATHS ARE BROADSIDE TO THE VERTICAL AIR STREAM
AIR TURBULENCE
THE ABOVE THREE FACTORS MEAN HIGH DRAFT LOSSES AND NEEDLESSLY HIGH FAN POWER REQUIREMENTS
AIR IN
AIR IN
AIR IN
TYPICAL FORCED DRAFT TOWER
TYPICAL CONVENTIONAL INDUCED DRAFT TOWER
EXTERNAL WATER DISTRIBUTION — HENCE NO INTERFERENCE TO AIR FLOW
WATER IN
HORIZONTAL AIR STREAM FLOWS SMOOTHLY THROUGH THE HORIZONTAL FILLING LATHS
NO AREAS OF AIR TURBULENCE
AIR IN

THE MARLEY "DOUBLE-FLOW" HORIZONTAL INDUCED DRAFT TOWER

(DESIGN FULLY PROTECTED BY BASIC PATENT)

MARLEY HORIZONTALS COVER THE FULL RANGE OF COOLING TOWER REQUIREMENTS—



PROVED IN ALL KINDS OF SERVICES

LARGEST TO SMALLEST

MARLEY COOLING TOWERS

THE MARLEY COMPANY INC.
KANSAS CITY, KANSAS

73-A

(Continued from Page 138)

building a plant capable of producing a similar quantity of butadiene from petroleum.

3. Cracking processes involved in recovery of butadiene from petroleum would permit recovery of ethylene, principal basic material required for the manufacture of styrene and *iso*butylene, low cost basic material used in the manufacture of butyl rubber.

4. Butadiene, ethylene, and *iso*butylene required for the production of 34,000 long tons of buna S rubber and 7,000 long tons of butyl rubber could be produced without materially detracting from the normal gasoline and oil supplies. Petroleum processes for the production of buna S synthetic rubber utilize that portion of the oil that consists of the lighter fractions taken off in cracking, and after the requirements of rubber have been obtained the fuel oil left is not materially lessened in value.

5. Canada had a nearby oil refinery fed by pipe line, which would permit centralization of operations at one point and assure continuous operation, whereas production of butadiene and styrene from an alcohol base would depend on having a ready supply of tankers and tank cars.

Petroleum Base Synthetic

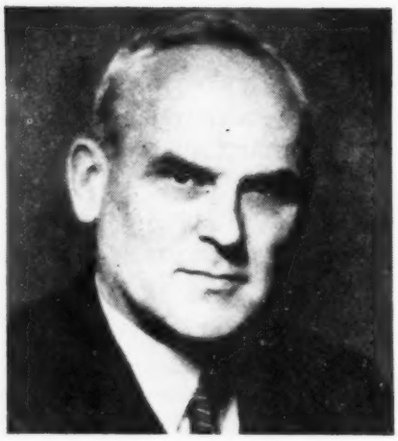
Building the Canadian synthetic rubber program on petroleum provided a self-contained economical and efficient operation for the following reasons:

1. The best available location selected provided an adequate area adjacent to one of the largest refineries in Canada, served by water, rail, and highway transportation, and at a relatively short distance from the plants of the Canadian rubber industry engaged in the production of tires. These plants will consume about 85 percent of the synthetic rubber to be produced.

2. Extension of the cracking facilities of one of the largest refineries in Canada provided the desired quantities of three gases for which a limited use had previously been found on a low cost basis. The gases are ethylene, *iso*butylene, and butylene.

3. Erection of styrene, butyl, and buna S copolymer plants on the property nearby permitted pipe line transportation without the costs, complications, difficulties, and dangers involved in tank car transportation.

Development of organizations to produce synthetic rubber in satisfactory amounts and qualities and of procuring or training the necessary operating personnel for the various plants in the Canadian project could, for obvious reasons, best be met and solved by following the main lines of the United States program.



Hon. C. D. Howe, Canada's Minister of Munitions and Supply, reviewed rubber program progress recently to House of Commons

Plant Construction

As a result of the survey, production of synthetic rubber in Canada has been centralized at Sarnia, Ontario, an area served by water, rail, and highway transportation, and at a relatively short distance from the plants engaged in the production of tires, which will consume about 85 percent of the synthetic rubber to be produced. The plant, owned by Polymer Corporation, Ltd., a Canadian Crown Company, is expected to be in production in the near future. Plant investment, operation, products, and by-products are owned and controlled by the Canadian Government. Although the project has been designed to meet the full war needs of Canada, it will not meet the peacetime needs in addition. It is expected, however, that it will wholly meet postwar needs with some allowance for industrial expansion. The government has invested between $40,000,000 and $45,000,000 in the corporation, which represents an average plant investment of approximately $1000 per ton per year.

R. C. Berkinshaw, president of The Polymer Corporation, Ltd., Canadian Crown Company

Imports of rubber substitutes of the buna S and butyl type between the two countries are exempt from customs duties and war exchange tax, and the same treatment has recently been extended to imports of butadiene.

Thiokol Plant

Although buna S is generally acknowledged the best synthetic rubber for the manufacture of tires, a Canadian plant is also manufacturing thiokol. The resistence to atmospheric deterioration of buna S is slightly higher than that of natural rubber. Buna S may be vulcanized with sulphur and rubber accelerators and cured to hard rubber. Tests have indicated that a combination of buna S synthetic rubber with nylon or rayon fabrics will make a tire that is at least 80 percent as long-lived as the best tire procurable from natural rubber at present restricted mileage speeds if used on ordinary passenger automobiles. Truck tires are being worked on similarly, but at the present time it is impossible to evaluate them. However, with further development and experimentation it is believed that a superior tire can be made from buna S.

A thiokol plant in Ontario began full-scale operations June 14. It is operated by Naugatuck Chemicals, Ltd., affiliate of the Dominion Rubber Company, Ltd. This was the first synthetic rubber manufacturing plant to begin operations in the British Empire.

Thiokol synthetic rubber is a development of the Thiokol Corporation, Trenton, New Jersey, and is one of the five commercially available types of man-made rubber. The complete output of the new plant has been placed at the disposal of the Canadian government for use in Canadian-made war equipment. Such products as airplane fuel tanks, collapsible air base gasoline storage tanks, fuel hose, gasoline tank linings, oil-proof coatings, etc., are made from thiokol. Thiokol is superior to natural rubber in its resistance to oil, grease, acid, and sunlight. It has a high impermeability to gases and water.

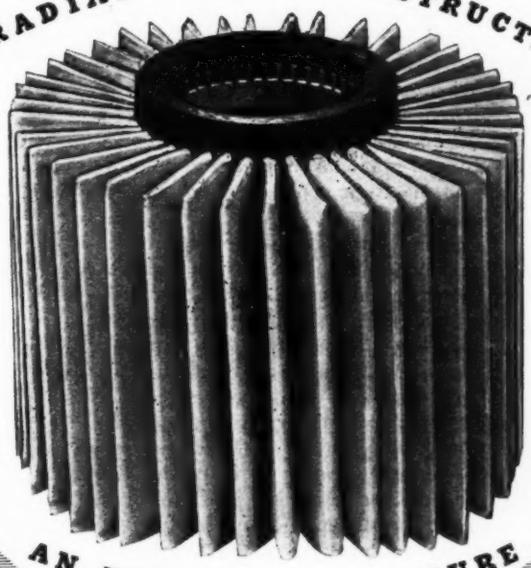
The discovery of thiokol was made during experiments to produce an antifreeze and is compounded from the products of sulphur and salt mines and natural gas wells. Coupled with the large output of the Dominion Rubber Company's reclaiming plant, thiokol production is expected to aid materially in extending that country's existing supplies of crude rubber.

Rubber and Wheat

In the production of synthetic rub-

THE HEART OF EVERY PROTECTOMOTOR

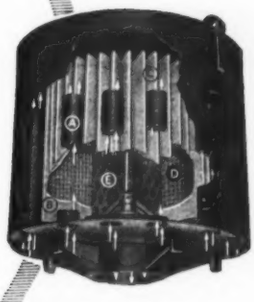
RADIAL FIN CONSTRUCTION



AN EXCLUSIVE FEATURE

MODEL D
INTAKE FILTER

MODEL CPH
AIR LINE
FILTER
(Sectional View)



MODEL DS
INTAKE
SILENCER FILTER
(Sectional View)

MODEL CPHS
AIR LINE
FILTER
(Swing Bolt)

1. Provides *positive dry type filtration.*
   - (a) Cleanable (washable).
   - (b) Performance unaffected by temperature changes.
   - (c) Essential for intake service on non-lubricated compressors.
   - (d) Can be selected oversize for severe conditions —does not depend on closely held air velocities for high efficiency.

2. Provides *largest possible active filtering area* in relation to space occupied.
   - (a) Ideal for dust storm areas.
   - (b) Low resistance to air flow.

3. Provides *maximum resistance to pulsation* through rigid design.

Representatives in Principal Cities

STAYNEW FILTER CORP. "Air Filter Headquarters"

2 Centre Park — PROTECTOMOTOR AIR FILTERS — Rochester, N. Y.

ber from wheat the method most widely discussed was to produce alcohol and then to make butadiene from alcohol. It has been estimated that the cost of production of industrial alcohol from grain at 80 cents a bushel would be from 50 to 60 cents a gallon, with the cost of conversion alone estimated at approximately 15 to 17 cents a gallon. When other costs are taken into account, it would require that, as a practical proposition, grain be purchased at a price from 25 to 30 cents a bushel. The production of butadiene from a petroleum base does not, however, preclude the possibility of using an alcohol base at some future date should it be found economical and advisable to do so. It is estimated that a gallon of alcohol yields approximately 2.75 lb. of butadiene, and that the theoretical yields of butadiene from alcohol and butane respectively are 59 percent and 93 percent by weight, and that the cost of producing butadiene from industrial alcohol is about three times the cost of production from butane.

If all feasible Canadian rubber requirements were made from a wheat base it would probably utilize no more than 15,000,000 bushels. Canadian wheat in storage as of March 31, 1943, the last estimate, was 798,000,000 bushels. The estimated Canadian production of alcohol in 1943 is 14,000,000 gal., which would require about 7,000,000 bushels if the total were made from wheat.

Milkweed Latex

Synthetic rubber quality has been found to be highest after a certain amount of natural rubber has been added. Cooperative enterprise involving the scientific service of the federal Department of Agriculture, responsible for the production phases of the program, the applied biology division of the National Research Council, which is engaged in perfecting methods for the extraction of rubber from these plants, and the chemistry division of the National Research Council, which is engaged in processing it, is carrying out a program to obtain this natural rubber. The department of botany of the University of Toronto is also working on fundamental problems of selection, breeding, and analysis in connection with the program.

The research in this field was undertaken in June, 1942. Of the numerous plants tested, it was found that milkweed had the most potentially adaptable qualities. In January, 1943, a method for the mechanical extraction of rubber gum from this plant was evolved. Preliminary investigations indicate that this gum will blend well with the buna S synthetic product to be produced in Canada, decreasing the heat embrittlement properties, increasing tear resistance, and improving tack and processability.

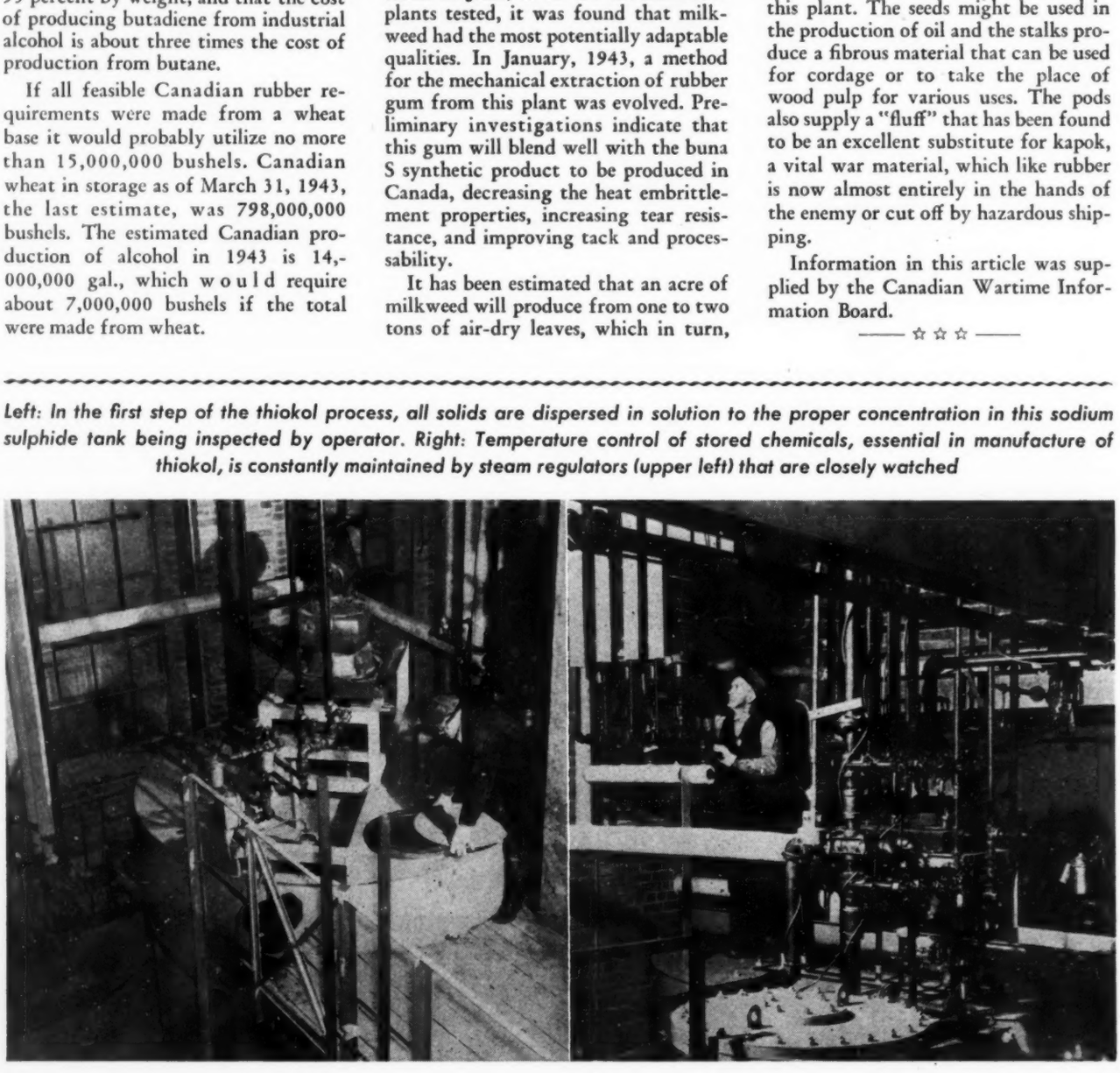
It has been estimated that an acre of milkweed will produce from one to two tons of air-dry leaves, which in turn, will yield from 150 to 300 lb. of gum. The leaves of the milkweed must be gathered, dried, cooked in an alkaline solution, washed, and the resulting compound crushed and ground in a pebble mill. An experimental processing mill in Ottawa is expected to produce about five tons of milkweed gum during 1943. This is to be obtained from wild stands harvested by school children and farmers under the general direction of the federal Department of Agriculture. Other experiments have been conducted with goldenrod, dogbane, and koka-sahz, Russian dandelion. Rubber produced from the latter plant compares favorably with Malayan rubber but production costs are somewhat prohibitive at present.

The rubber of the milkweed is found in the leaves and the seeds are in pods. It is believed that some type of combine would be satisfactory for harvesting this plant. The seeds might be used in the production of oil and the stalks produce a fibrous material that can be used for cordage or to take the place of wood pulp for various uses. The pods also supply a "fluff" that has been found to be an excellent substitute for kapok, a vital war material, which like rubber is now almost entirely in the hands of the enemy or cut off by hazardous shipping.

Information in this article was supplied by the Canadian Wartime Information Board.

—— ☆ ☆ ☆ ——

Left: In the first step of the thiokol process, all solids are dispersed in solution to the proper concentration in this sodium sulphide tank being inspected by operator. Right: Temperature control of stored chemicals, essential in manufacture of thiokol, is constantly maintained by steam regulators (upper left) that are closely watched



OTIS Sub-Surface Facts

No. 6 1943 DALLAS, TEXAS

OTIS TYPE G (Side Door) CHOKE SIMPLIFIES THE COMPLETION & PRODUCTION OF TWO ZONE WELLS...

Makes Possible the Taking of Bottom Hole Pressures of Each Zone Independently of the Other

The Otis Type G Side Door Choke has been generally accepted by the oil industry as standard equipment for use in completing and producing two-zone flowing wells.

The Side Door Choke provides a means to positively open and close circulating ports above a packer without moving the tubing string or breaking the packer seal. This makes it possible to set the packer, land the tubing and permanently hook-up the surface connections before bringing in the well, thereby greatly facilitating two-zone completion operations.

The Side Door Choke provides a means to actually record, with a regular bottom hole pressure gauge, the formation pressure of the upper zone independently of the lower zone. This can be done without moving the tubing string or resorting to uncertain calculations.

The complete operation is performed under pressure with the same steel measuring line used to run the bottom hole pressure gauge and requires only three to four hours.

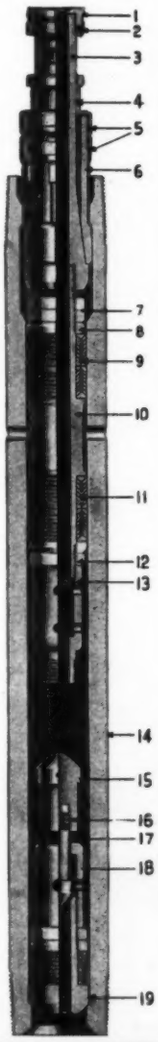
OTHER USES OF SIDE DOOR CHOKE ASSEMBLY

The Otis Side Door Choke also provides a means to accomplish the following:

- To acidize either zone of a two-zone well independently from the other zone.
- To recondition mud back of the packer without exposing the pay zone to the mud column.
- To take bottom hole samples from either zone of two-zone well.
- To serve as a removable jet collar in a gas-lift operation.

SERVICE—Otis Pressure Control maintains experienced crews and service trucks for the installation of all Otis Sub-Surface Tools.

NEW V-TYPE ASBESTOS BASE PACKING ON OTIS SIDE DOOR CHOKE

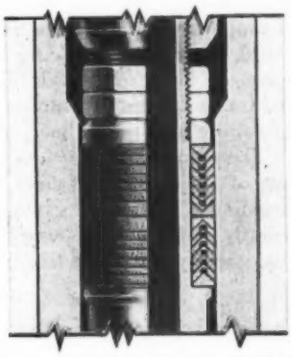


1. Retaining Nut
2. Set Screw
3. Mandrel
4. Slip Carrier
5. Bands
6. Locking Dogs
7. Upper Split Packing Nut
8. Packing Ring
9. Upper Chevron Packing
10. Side Bean Packing Mandrel
11. Lower Chevron Packing
12. Lower Packing Nut
13. Bean Cage
14. Landing Nipple
15. Nut
16. Rivet
17. Drop
18. Valve Cage
19. Cup Mandrel

NEW DESCRIPTIVE FOLDER
on
OTIS TYPE G *(Side Door)* CHOKE
Complete Details on All Its Uses
• **WRITE FOR YOUR COPY NOW** •

WITHSTANDS BOTTOM HOLE TEMPERATURES IN EXCESS OF 400°

New V-Type asbestos base packing, inert to acid and alkalies and capable of withstanding temperatures in excess of 400 degrees and pressures exceeding 5,000 p.s.i., is now



being used on Otis Type G Side Door Chokes.

The change was made advisable after difficulty was encountered with the former valve cups in certain deep high pressure distillate wells. Under extremely high temperature and high pressure conditions, both the fabric and the bonding material in the former choke cup were subject to deterioration.

The new V-Type packing completely overcomes this difficulty. Made of many layers of asbestos cloth bonded by a cementing material that resists acids, it is strong enough to withstand any well pressure or temperature encountered. The new packing has $\frac{3}{4}$" thickness, whereas the old type was only $\frac{3}{16}$" thick, increasing its strength in the same proportion.

The Type G Side Door Choke with the new packing element assures positive performance regardless of bottom hole temperatures or pressures.

OTIS PRESSURE CONTROL, INC.

DALLAS, TEXAS

Portable Power Unit for Pipe Line Pumping

☆ Large gas engine converted to self-contained Diesel set-up

CONVERSION and adaptation of a modern, gas-fueled, stationary type engine, to a portable Diesel power unit complete for field service, is reported to The Cooper-Bessemer Corporation, a pioneer heavy engine builder of Mount Vernon, Ohio, and Grove City, Pennsylvania.

The idea was worked out by engineers of a major pipe line company of Tulsa, Oklahoma. This large portable Diesel unit answers a critical need by supplying convenient temporary pumping service for transporting crude oil through the trunk line to provide quickly an increase from 30,000 to 40,000 bbl. per day, and can also be used for transporting crude oil from new wells through temporary feeder lines to main trunk lines, thus replacing several engines of less capacity. It can also be used as a temporary unit in the event of failure of a trunk line unit.

The complete, heavy-duty gas unit, one of six Cooper-Bessemer Type EN, 8-cylinder stationary gas engines previously installed at a pumping station, was quickly converted to oil fuel operation. Mounted on a base of 18 in. "I" beams, complete with all auxiliary equipment as shown in the accompanying photographs, it can be quickly transported to new field locations and placed immediately in service.

The effectiveness of this field service idea can be judged by the simple hook-up necessary to put the converted unit into operation. Once it is placed in the desired position, the procedure consists merely of making the crude oil intake and discharge connections. Then the unit is ready to handle a minimum of 700 bbl. of crude oil per hour at 700 lb. pressure.

In making the change, the gear increaser originally used with the gas unit was retained, and a new pump was installed. Starting equipment is of the compressed air type driven by the small engine mounted at the front operating side of the Diesel, with tank for air storage situated under the operator's platform as shown in Fig. 1.

A direct current generator is fitted at the flywheel of the engine to supply power for lighting.

The heat exchanger, mounted along the length of the base skid (Fig. 2) is connected from the discharge of the crude oil pump to the crude oil feeder line, the oil acting as the cooling medium for the exchanger cooling the jacket water.

To complete this self-contained unit, are two Nugent waste pack oil filters, one for filtering fuel oil and one for filtering lube oil, and two fabricated boxes, as shown in Fig. 2. One box holds the necessary tools and spare parts and the other is used for storage of renewal waste packs, wiping rags, and other essential supplies.

After the conversion had been completed, construction engineers were able to stand a five cent piece on edge on the unit while it was being tested—noteworthy evidence of the smooth operating efficiency and perfect balance of this Diesel engine and supplementary equipment. In fact, while delivering 900 lb. pressure during the test, 200 lb. in excess of the desired 700 lb., the coin remained upright, attesting to the lack of vibration and to the sound construction design of the engine and mountings.

Company officials were so well pleased over the performance of this Diesel unit that a second similar unit is under consideration.

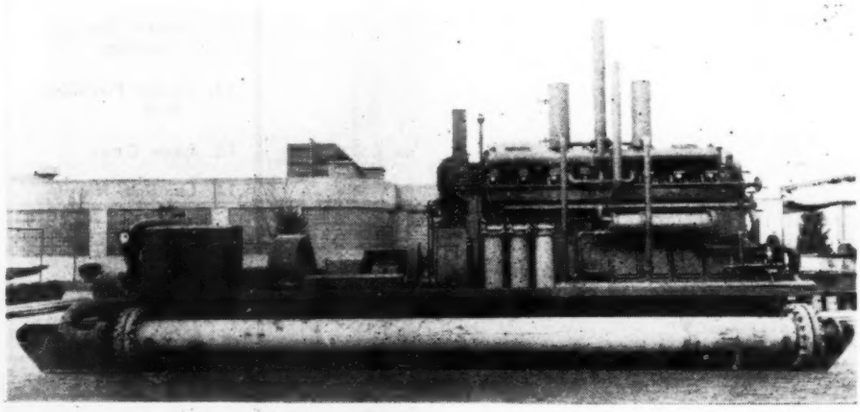
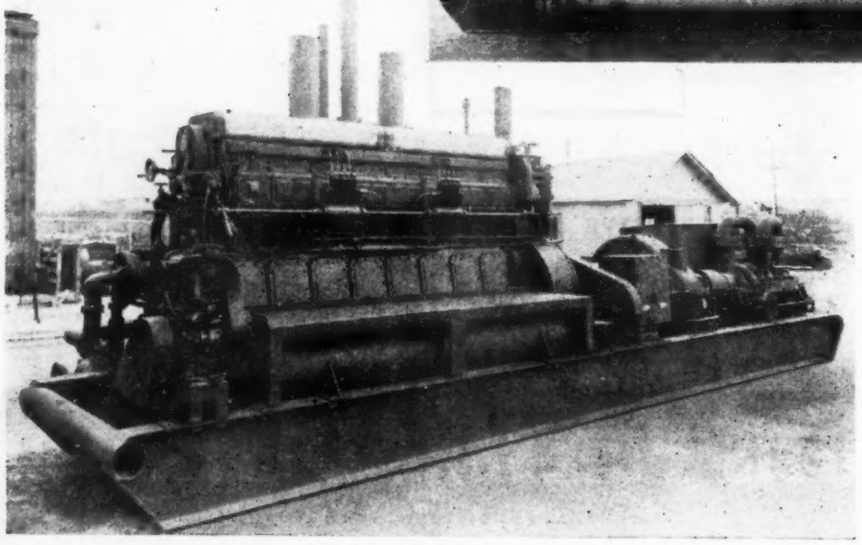


Fig. 1 (below). Operating side of the 8-cylinder Diesel engine, converted for field pumping use

Fig. 2 (right). Opposite side of heavy duty power unit



THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT NO. 76

A VALUABLE and regular feature of *The Petroleum Engineer,* the Continuous Tables, now in their seventh year of publication, were designed to save time and effort for the technician and the practical field or plant worker. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer.* Data are presented in the simplest form available with many types of information included that are best presented by curves or nomographs when three or more variables must be considered simultaneously. More than 450 tables have been published.

The Continuous Tables have developed as a result of suggestions for new tables, direct contributions, and improvements to existing tables by members of the petroleum and related industries, including manufacturing concerns, who are continually searching for practical information reduced by computation to tabular form readily applicable to the problems daily confronting them that might otherwise necessitate a more or less tedious calculation. These contributions and suggestions from the industry have resulted in a valuable exchange of information and data contributing to the progress of the industry as a whole.

To readers of *The Petroleum Engineer,* who are only now becoming interested in the Continuous Tables, it should be pointed out that each table is assigned a filing or index number that conforms with the Dewey Decimal System of classification as modified and extended for the petroleum and related industries by L. C. Uren, professor of Petroleum Engineering at the University of California. This complete index has been published in earlier installments of the tables and is now available in booklet form at a cost of 50 cents per copy from *The Petroleum Engineer,* P. O. Box 1589, Dallas, Texas. Complete sets of the tables from the first installment to the present are also available in conjunction with subscriptions at the rate of $3.00 a year, or $4.00 for two years. General field classification numbers are as follows:

Nos. P000-P399—General

Nos. P400-P-499—Drilling

Nos. P500-P599—Production

Nos. P600-P699—Transportation and storage (includes pipe line)

Nos. P700-P799—Refining, including

Nos. P770-P799—Natural Gasoline, which may be classified in a separate division as shown here if of special interest to the user

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*This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-24, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941, issue; 48-60, inclusive, in the June, 1942, issue, and 61-72, inclusive, in the June, 1943, issue.

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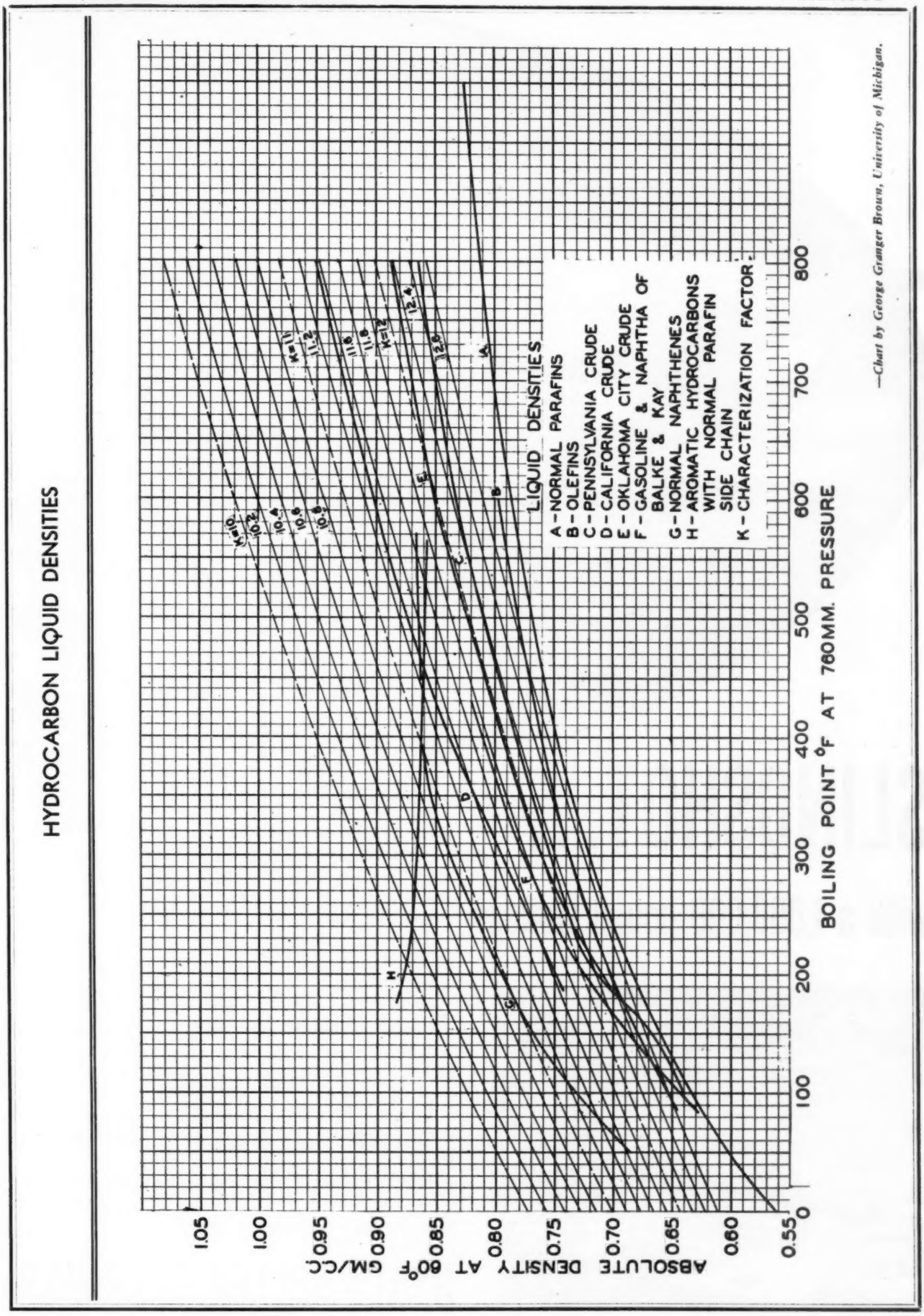
HYDROCARBON LIQUID DENSITIES



—Chart by George Granger Brown, University of Michigan.

SLINGSHOT...

with a 1,000,000 pound wallop!

From the deck of a ship a plane is shot into the air ...catapulted by a giant "sling" that imposes a load of about one million pounds on the Hyatt Roller Bearings in its mechanism.

What a wallop!

And what a bearing... that possesses the necessary design, precision and toughness to handle such load extremes!

Years of peacetime experience, in applications undergoing parallel punishment... like ingot cars, mill motors, shaping presses, railroad journals, etc. ...have enabled Hyatt to "inbuild" the stamina needed to take loads as they come.

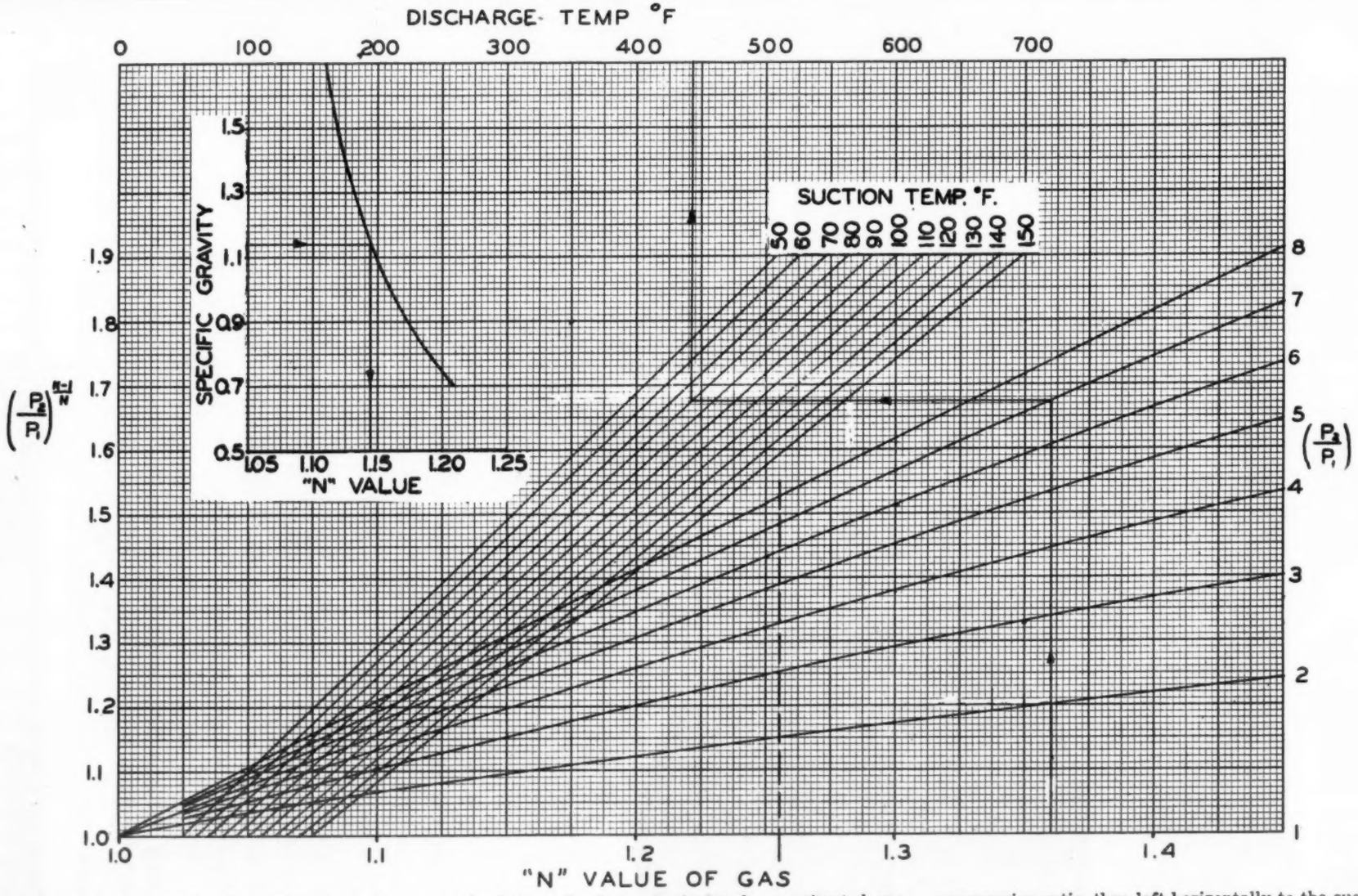
In the battle of production... as on the battlefield... Hyatt Roller Bearings are fighting to win this war.

Fighting against friction... and for America!

Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

HYATT ROLLER BEARINGS

GAS COMPRESSION TEMPERATURES AND VALUES OF "N"



The above chart permits determination of compression temperatures of gases from the formula $T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{\frac{N-1}{N}}$. The "N" value of the gas can be obtained from the known, calculated, or estimated specific gravity from the small curve in the upper left of the chart. After locating the "N" value on the abscissa of the main chart it can be followed vertically to the compression ratio, then left horizontally to the suction temperature, then vertically to the discharge temperature. Arrows show direction through chart.

—Chart by G. R. Davis.

HAZARD LAY·SET *Preformed* REWARDS YOU BY—

One of these invariably justifies its specification

1 LASTING LONGER
2 BEING SAFER TO HANDLE
3 SPOOLING BETTER
4 **RESISTING BENDING FATIGUE LONGER**
5 REFUSING TO "PORCUPINE"
6 MAKING LANG-LAY MORE SERVICEABLE
7 BEING FREE OF TENDENCIES TO KINK
8 REQUIRING NO SEIZING WHEN CUT
9 BEING FASTER TO INSTALL
10 GIVING YOU GREATER DOLLAR VALUE

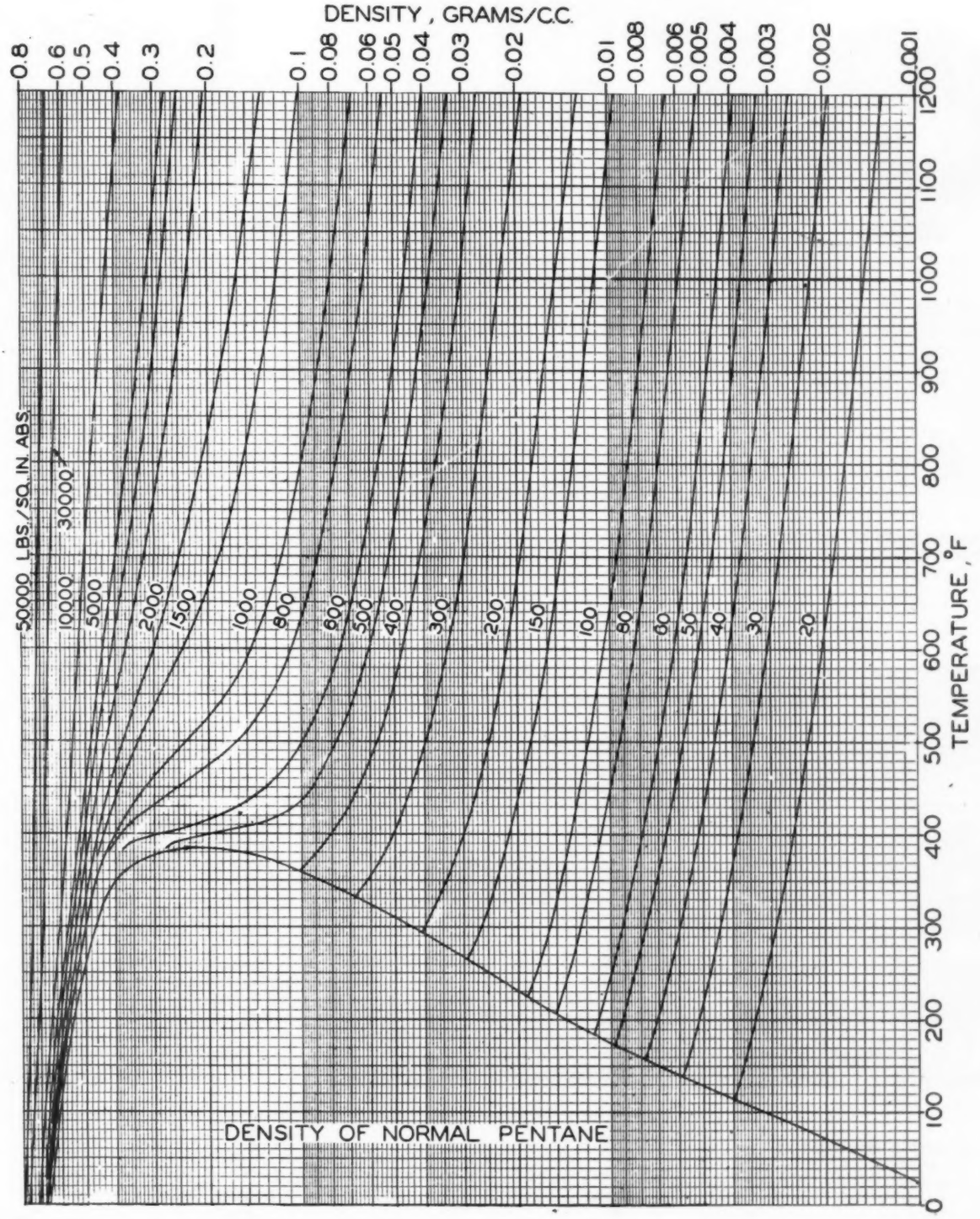
In Hazard **LAY-SET** Preformed wire rope there are no internal stresses to cause the rope on a drum to climb over or roll away from an adjacent wrap of rope. The resistance that **LAY-SET** has to whipping also contributes to good spooling. **LAY-SET** spools uniformly even under light load and at high speed. This increases its life by avoiding the nicking, scarfing and crushing that take such a severe toll of many wire ropes on the drum. Specify Hazard **LAY-SET** Preformed for all its built-in advantages.

HAZARD WIRE ROPE DIVISION • Wilkes-Barre, Pa., Chicago, Pittsburgh, Fort Worth, Houston, Wichita, San Francisco, Denver, Los Angeles
Distributors in all important oil field centers
AMERICAN CHAIN & CABLE COMPANY, INC. • BRIDGEPORT, CONNECTICUT

GREEN SIGNIFIES SAFETY

HAZARD LAY·SET *Preformed* ROTARY LINES

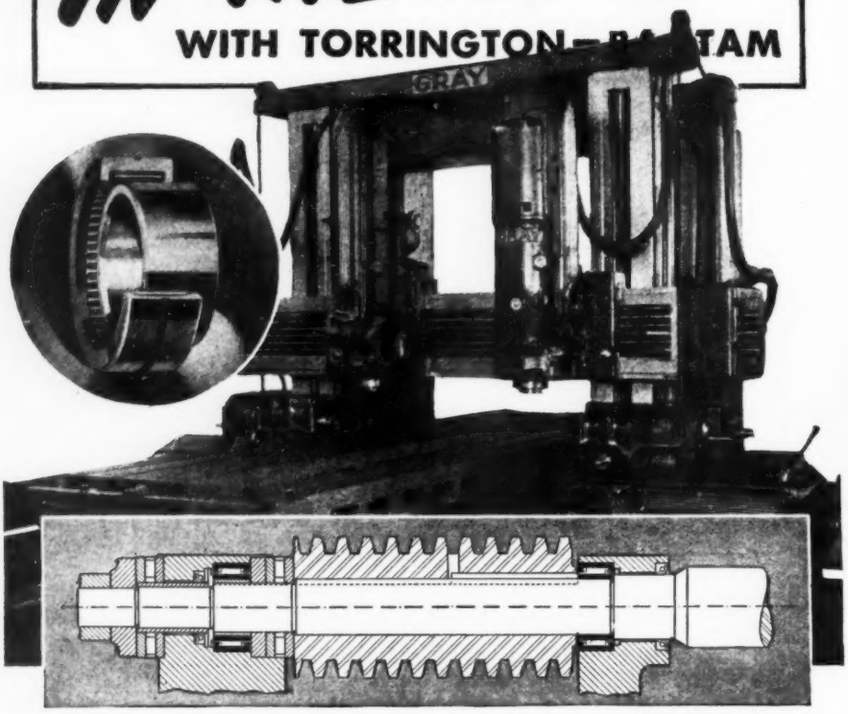
DENSITY OF PROPANE



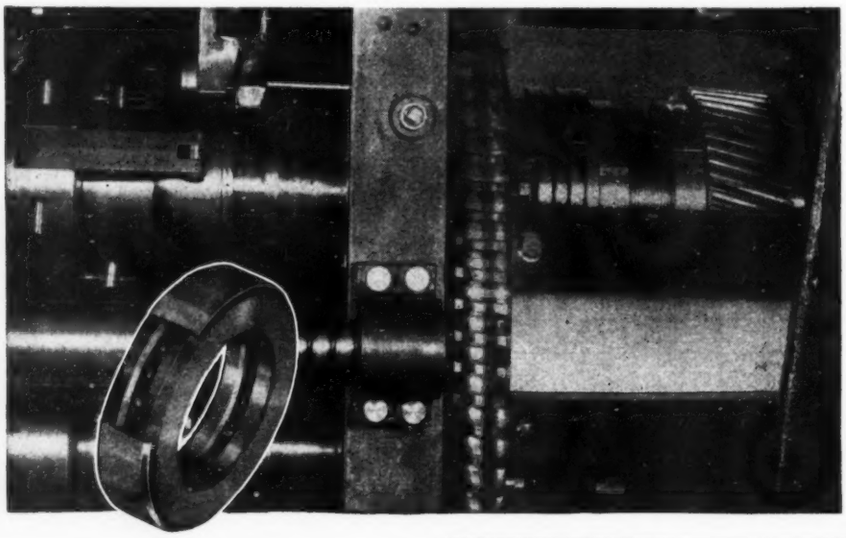
—Chart by George Granger Brown, University of Michigan.

IN THE NEWS

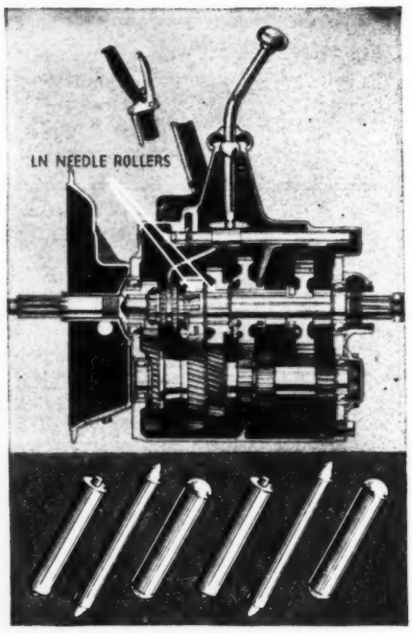
WITH TORRINGTON—BANTAM



SPEED, FLEXIBILITY AND EASE OF CONTROL, usually confined to small knee-type machines, characterize this Planer Type Milling Machine manufactured by the G. A. Gray Company. Type NCS Needle Bearings and Roller Thrust Bearings are combined in an application on the spiral pinion mounting, as illustrated in the cross-section drawing. Because this pinion drives the heavy work and work table, and because torsional stiffness is a prime requisite, it is necessary to keep the pinion diameter small and the shaft diameter as large as possible.

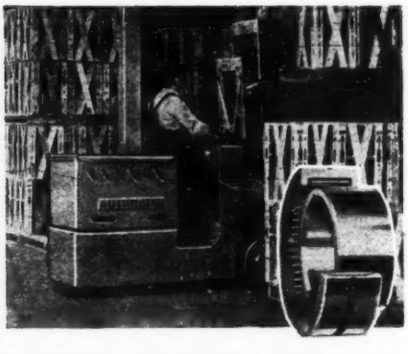


SPEED FOR WARTIME PRODUCTION has been the result of increased output of machine tools such as this Four Spindle Automatic Lathe manufactured by the Cone Automatic Machine Company, Inc. Among the many engineering features that contribute to the outstanding performance of these automatic lathes is the use on the work spindles of two types of Special Thrust Ball Bearings built by the Bantam Bearings Division, one of them measuring 9" O.D., 6¼" I.D., and 1⅞" in thickness, and the other 8¾", 6", and 1⅞".



UNUSUAL EASE IN SHIFTING, as well as quietness and long life under heavy service, are a few of the virtues of this Helical Gear Transmission manufactured by the Clark Equipment Company. The illustration shows the application of the high load capacity Type LN Needle Rollers on the mainshaft constant mesh gears, which contribute materially to the exceptional efficiency of this transmission. All types of Needle Rollers are included in the complete Torrington line. Our engineering department will be glad to make recommendations on the selection of the right type for your needs.

LIFTING TWO-AND-A-HALF TON LOADS is the job of the Standard Fork Truck illustrated here. Built by the Automatic Transportation Company, Type NCS Needle Bearings were selected for the sprockets at the top and bottom of the chain hoist which raises the telescopic uprights. Type NCS Needle Bearings with their high load capacity, ease of efficient lubrication and low friction coefficient are ideal for such heavy-duty applications.



ARMY NAVY

TORRINGTON BEARINGS

STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

THE TORRINGTON COMPANY · BANTAM BEARINGS DIVISION

SOUTH BEND 21, INDIANA

Desulphurization of Petroleum Distillates With Zinc Hydroxide[1]

☆ **Method permits by-passing sulphuric acid treatment and obtaining standard grade gasoline, naphtha, and gas free of hydrogen sulphide**

by K. A. Musatov and L. G. Krymova

Institute of Mined Fuel of the Academy of Sciences of U.S.S.R.

LAVROVSKII and Butkov,[2] and Velikobskii[3] refer to the unpublished investigation made by Musatov on the reduction of the sulphur content of Ishimbaevo gasoline from 0.7 to 0.023 percent as a result of treating the gasoline with zinc chloride. The same reagent was used as a desulphurizing agent in the work performed and discussed by Kuryndin and Ivanov,[4] Khisin,[5] and Firsanov.[6]

The authors of this report actually succeeded in desulphurizing not only gasoline with zinc chloride but also the higher boiling fractions of Ishimbaevo crude oil. The data on these experiments have not been published because the chemistry involved is not thoroughly understood; the desulphurizing effect of the required quantity of zinc chloride was not lasting, and excessively large amounts of the reagent had to be used.

The explanations given by Broun and Sivertzev,[7] and Kubul'nek[8] regarding the chemical reactions involved in the treatment of oils with zinc chloride cannot be accepted by the writers as those investigators assumed that a reaction took place between zinc chloride and mercaptans accompanied by the formation of zinc sulphide and hydrochloric acid in equimolecular amounts. In the desulphurization of petroleum distillates with solid zinc chloride no hydrochloric acid is produced and moreover, other sulphur compounds in addition to mercaptans, and including the sulphides of the fatty series also are removed. Analyses of the zinc chloride before and after the desulphurization experiments helped establish the fact that the quantity of zinc chloride does not change after the catalytic mass is dried whereas one of the products of hydrolysis, namely zinc hydroxide, disappears during the experiment, having been transformed into zinc sulphide. (See Table 1.)

In the "zinc chloride" desulphurization method, less than 10 percent by weight of the zinc is precipitated on a porous filter. About 10 percent by weight of zinc hydroxide is formed, consequently not more than 1 percent of the active reagent, based on the weight of the entire mass, is obtained, which, according to its specific gravity, will occupy less than 0.01 percent of the volume of the reactor. To make a more accurate determination of the desulphurization role played by the individual components in the preparation of the zinc-chloride mass, an attempt was made to eliminate the hydrolysis of the salt completely. Accordingly, another mass of zinc hydroxide that contained no trace of $ZnCl_2$ was obtained and experiments were conducted with this prepared mass on the desulphurization of Ishimbaevo naphtha showing, (Table 2), that zinc chloride does not remove sulphur. The sulphur content of the distillate, however, was markedly reduced by treatment with zinc hydroxide, and the reduction was so great that it seemed worthwhile to investigate the use of zinc hydroxide alone as a desulphurizing agent.

The simplest way to use the zinc hydroxide is in the vapor phase in the modified desulphurization process developed by Frash because in the solid state zinc hydroxide stabilizes hydrogen sulphide in the form of stable zinc sulphide. The thermal dissociation of sulphur compounds of crude oils leading to the dissociation of H_2S in the presence of zinc hydroxide will occur in the state of a continuously changing equilibrium. The zinc hydroxide desulphurizes more thoroughly and more rapidly than the metal oxides used in the Frash process at a corresponding temperature, length of time, and quantity of active mass.

The basic indices of the vapor-phase desulphurization of Ishimbaevo naphtha with zinc hydroxide were established in the laboratory. The desulphurization temperature ranged between 200 and 500°C. (See Table 3.) At a temperature of 200°C., 77 percent of the sulphur was removed from the naphtha; the degree of desulphurization increased with further increase of the temperature to 350°C. and then decreased for further increase of temperature to 500°C. The decrease in desulphurization with increase of temperature above 350°C. is explained by the rapid loss of the water of constitution at the higher temperatures, and the conversion of hydroxide into ordinary oxide, which is less active when sulphur is present. In a passage of naphtha vapors at a velocity of 0.2 liters of the distillate per hour per liter of the reagent at a temperature of 360°C. the initial removal of the sulphur amounted to 96 percent. In subsequent consecutive passages the increase in percent of removed sulphur proceeded at a slower rate. For the fourth liter of the distillate (toward

[1]Translated from the Russian oil publication *Vostochnaya Neft*, No. 7/8, 1940, by A. A. Boehtlingk, Berkeley, California.

[2]*Vostochnaya Neft*, 1939, No. 1, pp. 28-36. K. P. Lavrovskii and N. A. Butkov. Translated and published in *Foreign Petroleum Technology*, 8,292, 1940.

[3]*The Soviet Crudes*, A. S. Velikovskii. (Book in Russian.) GONTI, 1938, p. 307.

[4]*Khimiya Tverdogo Topliva*, 4, 578-85 (1933), K. S. Kuryndin and I. I. Ivanov. Translated and published in *Foreign Petroleum Technology*, 2, 292-3 (1934).

[5]*Goryuchie Slantsy*, 1934, No. 4, Ya. I. Khisin.

[6]*Khimiya Tverdogo Topliva*, 7, 143-54 (1936), E. I. Firsanova.

[7]"*The Chemistry of Sulfur Compounds Present in Liquid Fuel*," A. S. Broun and A. P. Sivertsev. (Book in Russian), ONTI, 1937, p. 121.

[8]*Neftyanoe Khozyaistvo*, 22, No. 2, 104-6 (1932), A. Ya. Kubul'nek.

TABLE 1

Components	Percent before and after desulphurization	
	Before	After
Zinc chloride	75	75
Basic salts	15	15
Zinc hydroxide	10	0
Zinc sulphide	0	10

TABLE 2

Comparison of the desulphurizing effect of pure compounds

Reagent	Percent sulphur in distillate before and after experiment	
	Before	After
Empty tube	1.19	0.760
Wood charcoal	1.19	0.680
Zinc chloride on charcoal	1.19	0.700
Zinc hydroxide	1.19	0.065

Note: The temperature of the experiment was maintained at 360°C.

TABLE 3
Desulphurization of naphtha at various temperatures

Number of the experiment	Temperature of the experiment, °C.	Percent sulphur in the distillate	
		Empty tube	Zinc hydroxide
0	...	1.06	.....
1	200	.....	0.220
2	250	0.760	0.140
3	300	.....	0.130
4	350	.....	0.065
5	375	0.460	0.085
6	400	.....	0.129
7	500	.....	0.260

Note: Control and treated distillates were washed with caustic after the experiment. The fraction boiling at 130 to 230 °C. was analyzed.

the end of the 24-hour run) the removal of sulphur in individual samples attained 88.5 percent. (See Table 4.) The mixture of all samples from a treatment carried out for 24 hours, using a single charge in the reactor, was desulphurized 90 percent. A slightly compressed hydroxide pulverized to 1 to 1.5 mm. and having a "loose" specific gravity of 0.4 was used in the experiment.

The loss of distillate toward the end of the 24-hour treatment amounted to 1.5 to 2 percent based on the weight of the raw material. About 1 percent of zinc sulphide, based on the weight of the distillate, was obtained from the extracted sulphur.

The desulphurization experiments were carried out as a batch process on gasoline having an end point of 130°C., a kerosine having a boiling point of 200 to 300°C., a cracked gasoline, Ishimbaevo crude oil, and naphtha. Preliminary experiments with these products showed that straight-run gasoline is completely desulphurized when its vapors are passed through the reagent once. The sulphur content of kerosine and cracked gasoline was reduced 75 percent, and 60 percent of the sulphur was removed from the crude oil. Results of the experiments are summarized in Table 5.

Continuous Desulphurization

Zinc hydroxide is readily soluble in dilute caustic solutions; is easily precipitated from neutral solutions, and it can be used in the solid form or as a liquid. If zinc hydroxide is used in liquid form it is most convenient to begin with ammonium zincate, which is obtained by dissolving zinc oxide in a concentrated aqueous solution of ammonia. Ammonium zincate evolves ammonia when heated and zinc hydroxide precipitates from the solution. This was the process used in a large scale desulphurization laboratory unit constructed to handle 5 liters of distillate per hour. In this unit, vapors of naphtha and the ammonia solution were passed continuously through individual lines into the reactor through an atomizer. A temperature of 200°C. was maintained in the reactor by the overheated naphtha vapors. Upon entering the reactor the ammonium zincate was atomized by the distillate vapors and the ammonium zincate decomposed into gaseous ammonia and finely dispersed hydroxide. The hydroxide reacted with the sulphur compounds of the distillate and collected in the reactor in the form of zinc sulphide. The ammonia, after completing the entire distillation cycle, was separated out in the gas separator and finally was absorbed by the water.

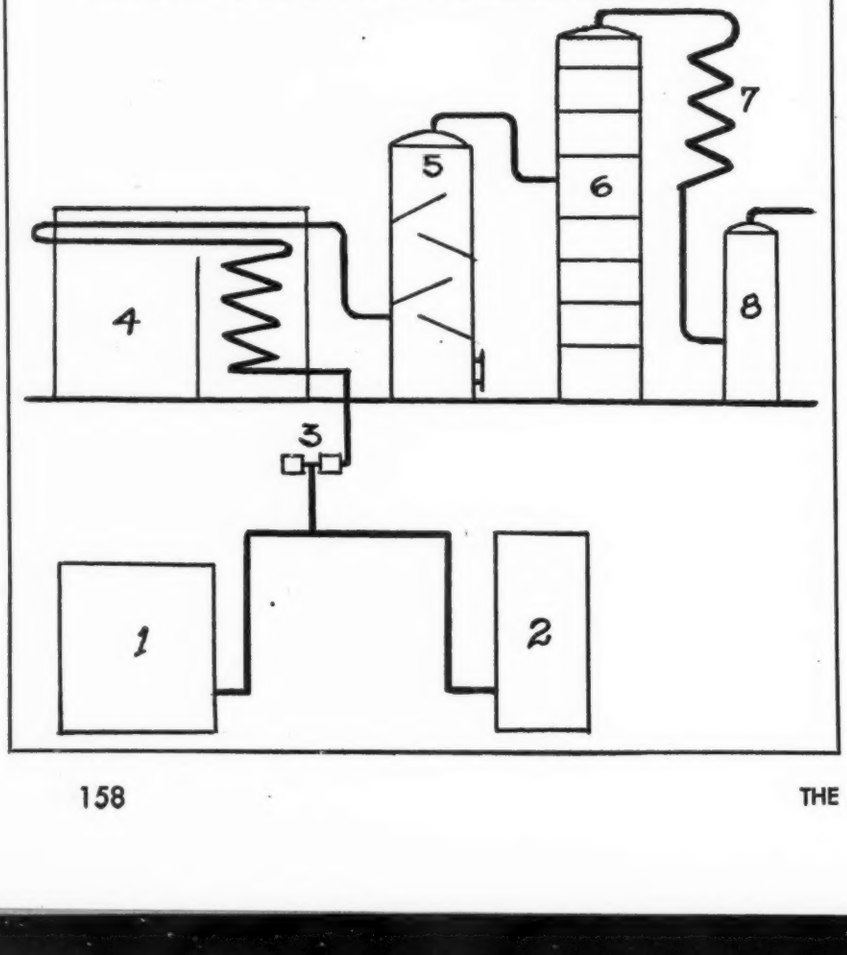
TABLE 4
Increase in the percentage of sulphur in the distillate as determined by one long-time experiment

Number of the sample	Amount of naphtha in liters passed through one liter of the reagent	Percent sulphur in the distillate
0	....	1.06
1	0.25	0.045
2	0.50	0.065
3	1.00	0.090
4	2.00	0.100
5	4.00	0.135
		0.11 average

Note: The original naphtha had a boiling point of 130 to 230°C.

In a larger plant it would be feasible to pump the solution of ammonium zincate and the distillate (or crude oil) through the tube still where the zincate will be decomposed to ammonia and hydroxide in the zone where the products are heated to 100°C. Contact with the sulphur compounds and the neutralization of acidic gases then will take place in the tube still itself as they are formed. Similarly, solid hydroxide could be pumped through the still as a suspension or fine powder. The layout of the continuous process shown in Fig. 1 is in its simplest form and as such is considered tentative and subject to change.

Fig. 1. Schematic drawing of a layout for continuous desulphurization. 1. Distillate; 2, zinc hydroxide or ammonium zincate; 3, pump; 4, tube still; 5, evaporator; 6, bubble tower; 7, condenser; 8, gas separator



Reclaiming Process

In the reclaiming process the basic mass of zinc hydroxide is converted into zinc sulphide. The zinc sulphide then is converted into zinc oxide by burning when sulphur dioxide is released as a gas. The zinc oxide is dissolved in cold concentrated aqueous ammonia with the formation of ammonium zincate. When the solution is heated ammonia separates out and zinc hydroxide is precipitated. The following chemical reactions take place:

$$ZnS + 3O = ZnO + SO_2$$
$$ZnO + 2NH_3H_2O = Zn(ONH_4)_2$$
$$Zn(ONH_4)_2 \longrightarrow Zn(OH)_2 + NH_3$$

The ammonia is absorbed by the water and is again used to dissolve new portions of zinc oxide. The separated SO_2 can be utilized in the manufacture of sulphuric acid. Reclaiming proceeds theoretically without losses or the consumption of reagents.

There are already industrial plants using similar processes such as sul-

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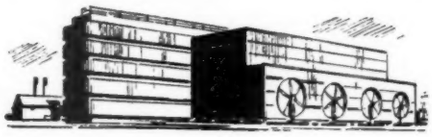

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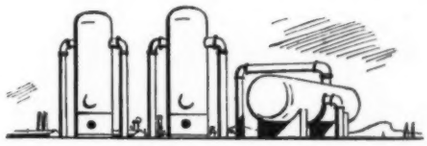

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phuric-acid plants that burn zinc pyrites to produce sulphur-dioxide gas. In the Konstantinoviskii plant in the Don basin, for example, by-product zinc oxide, which otherwise is difficult to dispose of, can be utilized to make up for the losses that may occur in the desulphurization and reclamation of zinc hydroxide.

Gases and Corrosion

Sulphur-containing crude oils (before distillation) usually contain solutions of chlorides in water emulsions. These chlorides are hydrolized and decomposed in the course of the distillation into hydrochloric acid and chlorine. Consequently, the oil-distillation equipment is subjected not only to the corrosive action of hydrogen sulphide and the products of its dissociation, but also to that of hydrochloric acid and chlorine.

Solid zinc hydroxide neutralizes the hydrochloric acid as well as the gaseous hydrogen chloride; it also combines with hydrogen sulphide at elevated temperatures. Gaseous HCl does not prevent the formation of zinc sulphide in the absence of water at temperatures in excess of 100°C.

TABLE 5
Desulphurization of Ishimbaevo crude oil and fractions

Fraction	Percent sulphur before and after desulphurization	
	Before	After
Crude oil	2.30	1.00
Gasoline	0.40	0.00
Naphtha	1.06	0.06
Kerosine	1.75	0.45
Cracked gasoline	0.40	0.16

In the experiments, a mixture consisting of equal volumes of HCl and H_2S gases was passed through a tube containing granulated zinc hydroxide. The gases passed through the tube at a velocity of two volumes of the gas per volume of the reactor per hour and the gases were completely absorbed at a temperature of 360°C. In the desulphurization of Ishimbaevo naphtha, as well as Ishimbaevo crude oil, the vapors that came from the reactor gave no qualitative reaction with silver nitrate or lead acetate and, therefore, contained no hydrochloric acid, chlorine, or hydrogen sulphide. Thus, zinc hydroxide not only acts as a desulphurizing agent for the removal of sulphur from distillates but also protects metal equipment against corrosion.

Conclusions

The limiting temperatures used for the thermal treatment of sulphur-containing crude oils (cracking) do not yield completely desulphurized distillates. The crude oil, therefore, is finally converted into gasoline, asphalt, and gas contaminated with hydrogen sulphide. Kerosine, Diesel fuel, and lubricating oils made from the crude oils here are excluded from consideration.

The treatment of crude oil and distillates with zinc hydroxide permits bypassing the sulphuric acid treatment and obtaining standard-grade gasoline, naphtha, and gas free of hydrogen sulphide. Kerosine and gas oils, however, are only partly desulphurized by the zinc hydroxide treatment.

The use of zinc hydroxide in the distillation of crude oils will neutralize hydrogen sulphide and hydrochloric acid in their nascent state and thus eliminate corrosion of the oil-distillation equipment, including its most important and expensive unit—the tube still.

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P 991.3

New Industries from Oil and Gas in Postwar Era

FIFTY to seventy miles to the gallon of gasoline is visualized by petroleum chemists in the postwar era, according to W. M. Carney, chief chemist of the Lion Oil Refining Company. Sealed cooling systems with petroleum product liquids in both cars and planes, 100,000-mile tires, and 20,000-mile lubricating oil are also predicted for this period.

In discussing the possibilities for the chemical development of natural gas and petroleum, Carney said that the peacetime volume of aviation gasoline will be tremendous. "There will be higher quality gasoline for the ordinary motorist," he continued, "as well as plenty of aviation gasoline for expanded civilian use of airlines and private planes.

"It is predicted that soon after the war, new automobiles will be manufactured that will require 90-95 octane gasoline. Technical men say that automobile gasoline mileage can be increased 50 percent or power 70-100 percent by using the aviation type fuel developed for war use. To get the most out of the new gasoline, will require new motors that will be smaller and probably made of light alloy steel and the bodies made of plastics made from petroleum feed stocks. Some of the most revolutionary developments of research during the war period have been kept secret for military reasons; for example, one major oil company has been testing a new aircraft grease designed to lubricate at minus 100°F., which is expected to have useful postwar applications in refrigerator equipment.

"The future will see 100,000-mile tires, 20,000-mile lubricating oil, 50-70 mile-to-the-gallon gasoline and sealed cooling systems with petroleum product liquids in both cars and planes. An unbelievable volume of crude oil and natural gas will be diverted to raw materials for plastics, for textiles that will replace linen and wool, as well as silk, and for commercial solvents and synthetic resins.

"Natural gas, usually found in the search for new oil fields, is about nine-tenths methane. We have enough proved reserves at present rates of consumption to last from 30 to 60 years. Ammonia plants, using natural gas as feed stock, can produce formaldehyde and methanol, among other things, and formaldehyde has become industrially important as feed stock for bakelite and urea resin plastics. Petroleum gas fractions are useful in making plastics, synthetic rubber, synthetic fabrics, such as rayon, solvents, explosives and aviation gasoline. Ethylene, a petroleum gas, can be used to make ethyl alcohol, plastics, styrene used with butadiene to produce rubber, as a surgical anaesthetic, to produce aviation gasoline, and in many other ways."

The oil industry is rich enough and progressive enough to raise a large family of healthy new infant industries from the thousands of new products incubating in its research laboratories, Carney concluded.

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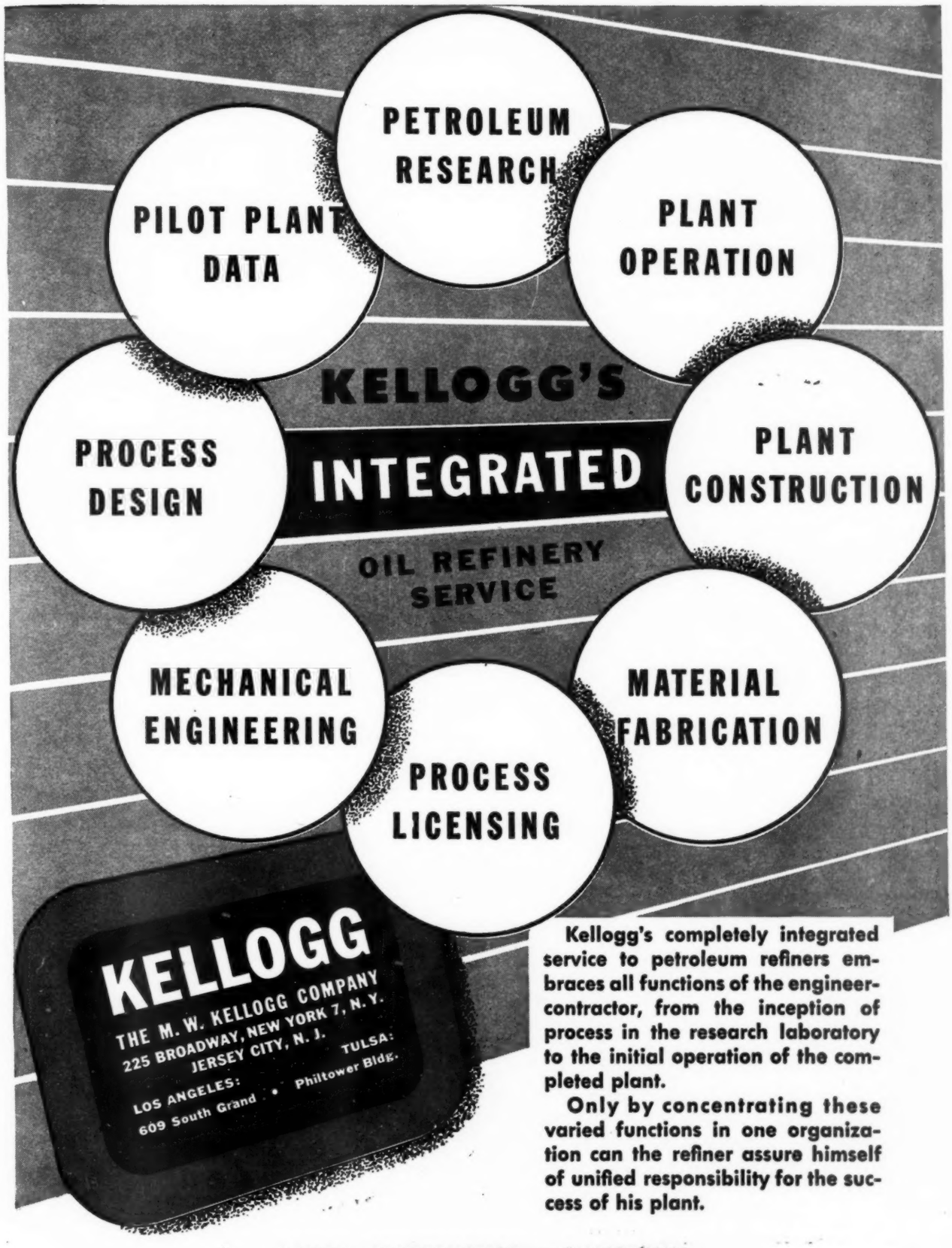

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Refinery Practice for the Operating Man

Vocational Class Proceedings in Refinery Engineering

Manufacture of Lubricating Oils

Class Meeting No. 12 (Concluded)

NOTE: Throughout the class proceedings, no attempt is made to distinguish the identity of the pupil speaking. When a series of remarks is made by pupils it usually denotes an interchange of discussion among the class members themselves.

Leader: Here is an instance. An untreated oil is placed in an apparatus using two polished plates held apart by three ball bearings that rotate with one of the plates and the thermometer immersed in oil. It is found that the untreated oil, i.e. with no addition agent, had more temperature rise.

(Writes)

	Untreated	*Treated*
90 min.	100°F. rise	77.6°F. rise

They believe that is a true index of less friction.

Pupil: Is there any particular pressure on the machine?

Leader: Apparently not. The description of the machine was written in 1937 and I did not look back to see if I had it. Here is another series of tests with pressures and this is by a different group.* The coefficient of friction is shown with technical white oil.

(Writes)

	100 lb.	*700 lb.*
White oil	0.0038	0.0018
White oil + ½ percent compound	0.0027	0.0016

They took the white oil and added ½ percent oiliness compound, and they made that with a bearing pressure that started in at 100 lb. up to 1500 lb. and the temperature held at 212 and 500 r.p.m. If we assume that a great many of the bearings operate around 700 lb., we find the friction values closer together. Putting all this into performance of the automobile gives data I am unable to supply. Can any of you contribute anything to that? We will agree it must have some merit.

Our text states that under low pressure, the oils as they are refined without addition agents seem to be satisfactory. Quoting:

"It is feasible to assume, however, that at low bearing pressures the oil is capable of protecting the bearings irrespective of the tenacity with which it adheres to the metal. At increased pressures, the ability of the oil to adhere to the metal becomes of increasingly greater importance, while, at very high pressures, chemical action of the lubricant on the rubbing surfaces is required in order to insure the presence of smooth surfaces even after they are slightly injured by direct metal to metal contacts."

The oiliness films may be solid viscous or fluid; in one instance metallic powders were added to oils being examined with the idea of absorbing the polar molecules from the compounded oils indicating that this selectivity might be expected and they found high selectivity with copper and lead. The coefficient of friction is adversely affected. Does that statement as to the polar groups coincide with your findings?

Pupil: When these polar bodies attach themselves to the metal particles, there is some heat given out.

Pupil: Now that we are on that subject, these polar molecules are supposed to be an ionizing compound and by ionizing, I mean electromotive force strong enough to break the next ion into separate ions. I understand these halogenated esters do not have that power. I mean to the extent of getting acid action. If they do not have that power, how are they going to attach themselves to the metal and be an oiliness characteristic? It seems to me that when the halogen is added the effectiveness is reduced.

Leader: You are assuming it takes an acid condition to clean the metal?

Pupil: If you reduce the acid strength you are reducing the oiliness.

Leader: In most cases there is an acid condition, but there are a few exceptions. I think some of the ketones act in that manner.

Pupil: That is the reason they had to give up weak acid. It was eating the bearings too much.

Leader: Would you think reduced wear will follow with increased oiliness? If there is no acid action, would you expect wear to follow?

Pupil: That would depend on whether it was friction of the oil or whether it was caused by metal contact.

Leader: Assuming, though, that you have good lubrication, there are a number of statements to be made; even in the case of full fluid lubrication, friction and wear may be offsetting factors. Quite often the product with superior oiliness will wear the most. Would that be found true in many cases with solvent-treated oils?

Pupil: To a large extent.

Pupil: Could such wear be considered erosion; by the constant flow of the oil across the metal surface?

Leader: I believe it could, in part.

Pupil: When you consider polar molecules in the used oil and you have suspended matter, the polar molecules electrify this suspended matter and they attach themselves to the metal surfaces making wear greater than ever.

Leader: Suppose we discuss oiliness carriers. Here is one of commercial importance—oleic acid.

(Writes)

Oleic acid—½ percent or more
Stearic acid—Even better—low solubility
Other acids
Mildly oxidized vegetable oils
Organic acid derivatives: e.g. Chlorinated esters of stearic acid

Leader: Now you can make a case for each of these. You can see how much laboratory work it takes in order to have a complete grasp of the subject.

Pupil: Do you mind if I write something? Plasticity has to do with the thickness of the film.

(Writes)

Plasticity
Intensified viscosity
Secondary bulk effects
Adsorption
Adhesion
Stratification

Pupil: I think there has been some work done toward the raising of the viscosity of certain oiliness agents and increasing oiliness by increasing viscosity, and the secondary bulk effect has to do with viscosity due to the pressures and temperatures that may be produced locally within the film itself, and possibly are on a molecular scale. The adsorption is about the most important on the basis of the action obtained, as adsorption does have to take place.

We can assume that if we have a copper or nickel surface and it would require a different additive agent than if

*"Oiliness in Its Relation to Viscosity in Lubricants," *National Petroleum News*, April 20, 1938.

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we were using iron, and right along with that we would have to assume that the iron would be wetted by one of these which would cause oiliness, while the copper or nickel would not be wetted by the same agent and would have to be selective in its action, and of course have perfect adhesion or freedom from slippage. You can imagine two lubricants of equal viscosity differing with respect to the maximum stress and which can be supported at the boundary and then if the operating conditions are such to exceed the initial stress value by either lubricant, there will be a difference in the friction of the lubricants.

Pupil: I agree, but I don't believe the intensified viscosity then will support the definition of oiliness.

Pupil: You would have a reduction in friction.

Pupil: Intensified viscosity is in the body of the film of oil, and the class decided that oiliness was only affected in boundary lubrication.

Leader: I will see if this definition would apply. An airplane engine during the takeoff puts the oil under high pressure raising viscosity from 6 to 12 percent; in a power dive, it may increase as much as 25 percent. This may amount to several thousand pounds. Wouldn't that be an intensified viscosity?

Pupil: A California company worked on all three types of oil, data on which will be given later on in the class.

Leader: Lube oil made from naphthenic base stock is affected most by pressure, Mid-Continent next, and Pennsylvania least.

Pupil: Perhaps Pennsylvania crudes are not the best lubricants then.

Leader: There are cases where the oil is actually an abrasive because of the effect of high pressure.

Pupil: The University of Kansas made tests where they put pressure on the Timken bearings, and ran them until the bearings seized—up to the point of 2000-lb. pressure. They found the same thing you have there about that viscosity; i.e. that the California oils increased most and Pennsylvania the least. They were using oiliness agents in two of them and the other was just an ordinary Mid-Continent oil and the oiliness agents would not prevent seizing after so long a time.

Leader: It appears timely to consider the use of anti-oxidants.

Pupil: Do you think that all these oils would be corrosive under any operating condition?

Leader: A great many are and some are only to a small degree. I believe it is a fairly general experience that you will likely have trouble with the cadmium, silver, and copper lead bearings among others and probably even low molecular weight acids are active. The troubles that have intensified the attention to this problem have been with these alloy bearings that have been substituted for babbitt to get away from fatigue. The high operating crankcase temperatures have emphasized the corrosion results, particularly with certain engines.

Pupil: At the time the addition agent forms a union with the metal, how does it get there? If you still have further ionization, then the metal sloughs off and corrosion becomes apparent. Wouldn't the corrosion start at the time this occurs?

Leader: Yes, that seems logical.

An extreme result from these difficulties is when you burn out the bearings. Do all of you realize that 5 years ago one popular make of car had frequent cases where after 400 to 500 miles of travel the bearings burnt out with certain oils? They found the top temperature in the piston travel area was about 510-530°F. and when that oil reached this high temperature it suffered too much oxidation. To meet these problems they have resorted to special steel-backed babbitt bearings, and it serves to give the needed strength; that is a nice example of the automotive engineer's coöperation with oil refiners.

Pupil: What is the softening point of the babbitt bearing?

Pupil: Approximately 400°F.

Pupil: I was just wondering whether the increase in the bearing temperatures themselves would be one reason why they tried to get away from babbitt bearings.

Leader: I think fatigue is the important limitation with the babbitt.

Pupil: Pure lead melts at about 620°F., and it is of higher melting point than most of its alloys.

Leader: Regarding the neutralization number, which is closely allied; the Socony-Vacuum Oil Company has made available the following information. We have oils A, B, and C and their neutralization numbers, and shall also tabulate the corrosion. As this was designed to give an index. Oil A had a neutralization number of 1.7 and Oil B had 1.0, and Oil C 3+. These were motor tests on the block; after 60 hours, running at high speed, Oil A produced a slight corrosion. Oil B, with the lower number would lead you to expect better results, but it went bad in 20 hours. That would be an indication that organic acidity built up to where it would attack and re-attack with thickening action, but there was no corrosion despite the fact.

Test with Oil C had to be discontinued after a relatively few hours because the oil became so thick they could hardly withdraw it from the crankcase. The general conclusion was that you would classify active acids as harmful to cadmium and hardened lead. There was no attack on steel or aluminum or any other engine metals. Then they checked the thickening material and found there was a granular carbon-like substance present. This however was soluble in chloroform, indicating an oxidation product rather than carbon.

(Writes)

Oil	*Neut. No.*	*Corrosion*
A	1.7	Slight at 60 hr.
B	1.0	Bad at 20 hr.
C	3+	No corrosion until above 3.0 —oil thickened.

Perhaps you remember the experience with certain popular make cars where sludge similar to coffee grounds choked them up. One oil company points out that sulphur-bearing inhibitors are effective, due to:

1. The precipitation of the metallic accelerators such as lead compounds.

2. Direct protection of the metal surfaces from corrosion, forming probably a metallic sulphide, retarding corrosion.

3. Failure of amine and polyhydroxy anti-oxidants to protect against accelerators.

You remember there is a theory that inhibitors may not act only as true anti-oxidants but they are also passivating catalysts. We can start in and list those anti-oxidants but I don't believe it is worthwhile. Compounds or inhibitors have had enough to justify mentioning them and Santolube C. C., which is an organic compound, is given as being a successful inhibitor. Here was one test using copper lead bearings, with and without inhibitor:

	With	*Without*
Copper lead	7 mg. loss	117 mg. loss
Cadmium-silver	6 mg. loss	1070 mg. loss

Those are weighed losses in all cases, and there are several more tests giving about the same characteristics. Then there is a table that gives the characteristics of the oil on page 194, Table 52, of the text.* When adding Santolube C. C. you will see very little effect on any characteristic except the neutralization number and that is raised from 0.0 to 0.3. You might have to inhibit the inhibitor in some instances. There is a wear test that is of interest, made on an aviation engine in which the weight loss with the additive was 0.001 in grams per hr. and without it, it was 0.006, and there was six times as much loss without it as with it, so our stories vary somewhat as to the effect, but I don't think they need to bother us because some inhibitors will work on some oils and will not on others.

One test concerning motor perform-

**Modern Methods of Refining Lubricating Oils* by Vladimir A. Kalichevsky.

NO. 9 OF A SERIES
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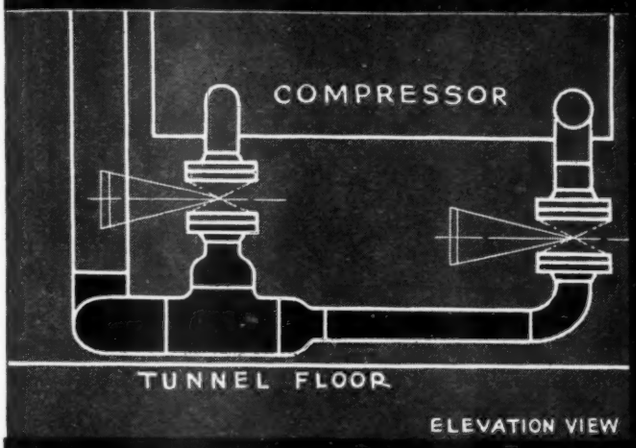

ELEVATION VIEW

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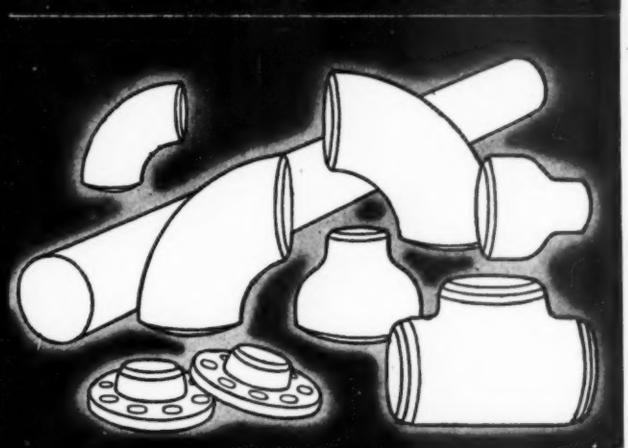

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FINAL STEP: Place Preassembled Piping Section into Position to Complete System

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ance has to do with volatility and consumption records and it points out that there is less consumption with high viscosity neutrals than with low viscosity neutrals, and another study is between carbon residue and engine deposits. I can say that carbon residue and engine deposits did not agree. There is a very interesting figure on the effect of cylinder finishing. If you go to buy a new car and they talk about super-finishing, with a little further inquiry you will find that they are talking about tolerance or smoothness of design you did not dare think about a few years ago. A relatively few years ago, this would be the cylinder walls, looking something like that (draws rough line on blackboard). Nearly all this is honed off and you have little of the ridge and valley effect. The projections above this straight line are held to values of something like 12 millionths of an inch down to as low as 2 millionths of an inch. According to some of these tests, which should be reliable, it may cut the consumption of the oil to where an engine might be using a quart of oil in 300 miles at 13 millionths of an inch, then by honing down to 9 millionths of an inch, they improved it so it used one quart of oil in 1500 miles.

Pupil: That may explain why you can take 3 different cars of the same make and get 3 different performances from each car.

Leader: There are some who say if you get this honing too fine the oil slides down the cylinder wall due to not having depressions in the surface, therefore when you start your car, wear will result due to dry walls.

Pupil: Wouldn't the car require less breaking in?

Leader: Yes, that is one of the benefits.

Pupil: That is another point where oiliness comes in; adhesion to the metal.

Leader: There is quite a little indication that you should continue to get good, smooth operation.

Pupil: Are the rings made so accurately that they will fit those hones?

Leader: No, I think you still must depend on the wearing-in method.

Pupil: It would appear that if you had the crankcase filled with oil that contains an oiliness carrier once, then every time you change oil you are wasting your money. If it is so strong that it forms a film over the surface and tends to reduce any other action, it looks as if it would be a waste of money not to use the same oil all the time.

Pupil: You have to have that adsorption right along.

Pupil: You think the oil plane will last?

Pupil: No, you need that adsorption continuously.

Leader: You have to keep renewing it. If you remember the Model T days when you wanted to stop and had to put your foot on all 3 pedals, your clutch bands would grab, so aluminum oleate was one of the substances added to the oil and another product was lard oil. As you used the acid, it did not work any more and you had to keep adding fresh oil. Would that be experienced in the case of this other oil if you did not have your agent to keep renewing the film?

Pupil: If you have to renew it too often you have that tying-in action continually going on and you will have corrosion.

Pupil: That is awfully hard to remove from metal.

Leader: We have some information on the effect of viscosity on the friction of the engine. In the tests, quite a big percental increase in power requirement was found, this in terms of fuel in lb. per hp.-hr. At 800 r.p.m. the SAE 50 oil had a consumption of 0.85 whereas the SAE 10 had 0.75 and at 2400 r.p.m. the difference was not so great. Evidently the oil warmed up. The SAE 50 had a number of 0.59 against 0.57 for the SAE 10. It is a matter of where to draw the line on what is a safe viscosity. One source was the experience of the City of Los Angeles; they determined the oil should have an operating viscosity of not less than 60 s.u. If you are going to have temperatures of about 210, you might want SAE 30 in order to protect the engine. Cars used by the City of Los Angeles had to drive across the desert. Last summer I drove across the same desert with SAE 10 in my car's crankcase. I don't believe in using heavier oils than necessary for the operating conditions.

Another man found that SAE 20 was safe for temperatures as high as 275 and 300. That did not agree with the Los Angeles information. They said that SAE 10 was probably safe for 200 temperature. I am sure I had mine above that.

Pupil: How about the viscosity index of the oils we use?

Leader: That is a very important point.

Pupil: Even though the addition agents for oiliness are valueless for common, ordinary usage in a passenger car, would they be of benefit in the breaking-in period?

Leader: Yes, I think they would. They would prolong the break-in period, however.

Tonight we conclude our study of lubricants, for a time at least. We have traveled quite a ways, reviewing oils of pre-refinery days and following through to the scientific period. Doubtless there will always be an art to refining but the guidance of science shortens the experimental period and hastens developments. Refining procedures will continue to be improved by the efforts of some of you and a great many others, and in the near future we possibly will have an intensive development of additives, even more than the considerable accomplishment to date.

Editor's Note: This concludes the series on the manufacture of lubricating oils.

☆ ☆ ☆

Catalytic Process for Isomerizing Normal Pentane to Isopentane

The Universal Oil Products Company has developed a catalytic process for isomerizing normal pentane to *iso*pentane.

The process is simple, continuous in operation, and easily controlled. It produces exceptionally high yields at relatively low recycle rates, and dispenses with the use of hydrogen, which is expensive and difficult to handle, according to Universal officials. Catalyst consumption is low.

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1. Give aviation gasoline the required vapor pressure of 7 lb.
2. Improve the octane rating, and
3. Increase the volume.

*Iso*pentane, in addition to being valuable in aviation fuel, will play a prominent part in the production of high-quality postwar motor fuels, it is stated.

Considerable amounts of *iso*pentane are contained in the base stock produced by catalytic cracking. It is necessary, however, to supplement this supply from other sources. One of these, natural gasoline, contains large quantities of normal pentane but a limited amount of *iso*pentane. The U. O. P. pentane isomerization process converts normal pentane to *iso*pentane economically and efficiently, it is asserted.

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PART 3 (Concluded)

by R. A. J. Dawson
Office of Petroleum Administration for War

Pump Drives

Electric driving motors for 20-in. stroke slush pumps should be of at least 400-hp. rating, and d-c. pump drive motors in use today are usually of the shunt wound, separately excited, splash-proof type with explosion-proof blower. Voltages of from 350 to 400 at from 900 to 1000 r.p.m. are necessary and full-load armature currents for such suitable machines range up to 1000 amp. The torque limit control feature of variable voltage d-c. equipment permits stalling of mud pump motors without endangering either pump or driving motor.

It is in the driving of large heavy power pumps that electric motors have their hardest field task, inasmuch as the load is constant for long periods of time. Constant high amperages are needed to maintain high torques and the heat developed must not be so great that it cannot be effectively dissipated by the cooling blast from the blower.

The largest power pump available today has a power end rating of 400 hp. and because of the high torque needed to handle the high-pressure fluid load the voltage (speed) is reduced so that the input rating of the pump is not exceeded.

Pumps of 18-in. stoke teamed with 300-hp. driving motors form a very efficient and economical combination for drilling to 11,000 ft. Usage of such equipment for competitive drilling past that depth is not generally recommended. An important advantage of this combination is that the total weight of both pump and motor is such that the unit can still be handled by large tandem trucks.

Large slush pumps are best driven by V-belt drives of either E or D section type. Modern practice is to use a 48-in. pinion shaft sheave driven by a 14-in. sheave on the 1000-r.p.m. motor shaft, which ratio will turn the 20-in. pump at rated speed. Twenty-inch power pumps have a full speed of about 54 s.p.m., the reduction accomplished in the power end being 4 to 1. In using 13-in. and 14-in. drive pulleys on the motor shaft approximately 16 V-belts should be used in order to accomplish the needed power transmission. Driving pulleys of this small diameter have sufficient arc of contact to drive effectively, even though they were considered too small for this usage until recently.

V-belt lengths of 330- and 370-in. in D section size are frequently used, and give good spacing of large units. The belts should always be kept taut by necessary adjustment of the tighteners, and must be kept clean and dry.

Operation of Slush Pumps

The efficiency of a power pump can be improved up to 30 percent by the use of mud tanks to provide a head on the pump suction. Mud tanks are being used to a great extent on steam rigs in Gulf Coast areas, and they are even more valuable on power rigs. Mud can be handled much easier and more economically in tanks and their use is an absolute necessity in many marsh locations and on barges.

A well-known oil-field tank manufacturer fabricates a light rectangular tank of 250-bbl. capacity that is about 8 ft. by 35 ft. by 5 ft. 6 in. deep, with stout I-beam base. Integral suction valves can be flanged directly to the suction hole of the tank, and their use allows much easier pump repair and workover.

On land wells three of these tanks should be used, giving a surface mud circulation volume of about 750 bbl., but on permanent setups on barges this amount should be increased to provide a larger working supply. Tanks of this type are good for dry land use, for marsh mat setups, and can be used on cargo barge decks in inland water locations to great advantage.

Two heavy-duty 20-in. stroke pumps are needed if fast, competitive drilling is to be done, and their tremendous weight is a very bad transportation handicap. It is hoped that the trend toward lighter welded construction of pumps of smaller stroke is followed far enough to reduce the weight of the longer stroke pumps. A considerable part of the weight is concentrated in the power end of the pumps as the pinion and bull gears must be strong enough to take the necessary power input load. The power ends of the large power pumps made today are housed in a very heavy cast alloy iron frame, and much design work will be necessary to reduce the weight of the pumps and maintain the strength.

Large liner sizes may be carried in the pumps in surface hole; however, it is necessary to reduce the liners as the hole deepens. Liners are cut down at regular intervals, (to 7¼ in., to 6½ in., finally to 5½ in.), in order to allow the electric driving motor to maintain an efficient speed, and thus accomplish the same power input to the pump gear end.

Little experimentation has been done on the field cooling of large electric motors, and from all indications addition of high powered and greater volume blowers would result in improved oil-field performance. With the exception of the blower inlet, all rig motors are made as splash-proof as possible, as the majority of insulation trouble results from entrance of water, dirt, and other foreign matter into the motor. The blower suction should be well shielded, and on permanent barge installations is often carried overhead to eliminate all possible contamination. Blowers should be unitized as much as possible with the motors being cooled, and it is considered good practice to keep them running constantly, so that possible failure can be more easily detected and corrected. Motors used on cooling blowers range from 5 hp. of Manufacturer "B" through 3.5 hp. of Manufacturer "C" to a low of 1.5 hp. in Manufacturer "A".

Water Pumps

Reciprocating power pumps of conventioned 4-in. by 10-in. and 5-in. by 8-in. types are used to provide high-pressure water supply. If either three or four large generators are used the water pump has sufficient flexibility if it is driven in parallel with the mud stirring pumps. Armature leads are so arranged that the water pump cables by-pass the transfer switch and tie directly into the generator terminals, so that the water pump may operate constantly while the slush pumps may be changed at will by the transfer switch.

By paralleling off one generator, the

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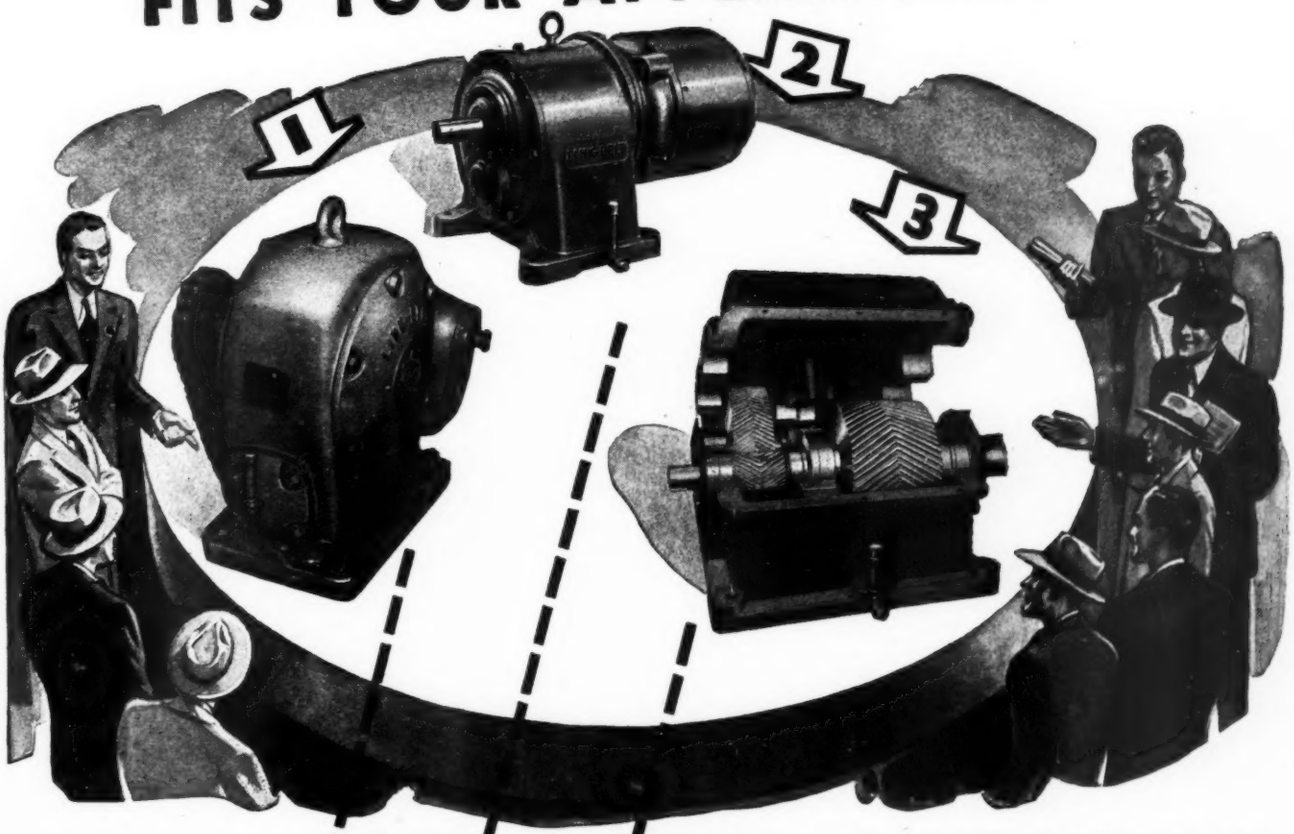

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parallel demand is always on that generator, and if it becomes necessary to switch pumps on the hole, the water pump cannot erroneously be paralleled with the hole pump. It is always parallel with whatever pump is serving as the stirring pump.

The supply of high-pressure water should be constant so that operation of the blowout preventer will always be possible, and a 50-hp. pump drive motor should be used in order to have sufficient reserve power. The voltage of this motor should be the same as that of the larger motors because it will often have full voltage imposed upon its windings, even though an armature resistance is used as a partial speed control. The drum throttle control will vary the speed of both of the paralleled motors with the armature resistance providing further necessary adjustment. Both the water pump and its controlled armature resistance cabinet should be placed near the mud pumps in order to centralize pump controls.

At least one small unitized centrifugal pump should be available for washdown purposes, these compact machines being driven off the exciter circuit. By using salt or waste water these pumps can save large volumes of valuable water, and serve in emergencies as a fresh water supply pump.

Drawworks Operation

Drawworks should be driven by a 350-volt, 1000-r.p.m. motor of at least 400- 600-hp. through a reduction gear of about 2.25 or 3.0 to 1 ratio. The exact reduction depends to a large degree upon the sprocket ratios through the drawworks, but the motor should be turning its rated r.p.m. when the normal high rate of drilling line travel is being pulled.

The reduction gear drive to the drawworks should be a combination 13-tooth and 17-tooth double-chain 1240 sprocket to a jack or driveshaft sprocket ranging from 16 to 20 teeth depending upon drawworks sprocket ratios. In drilling to 11,000 ft. or more, the larger sprocket on the reduction gear shaft can be used, switching over to the 13-tooth sprocket in order to let the electric motor pick up enough r.p.m. to get up into more efficient operating speeds. Reference to the d-c. generator characteristic curve, Fig. 4, will show the importance of maintaining sufficient speed in both generator and motor units.

The usual large electric motor of this type must develop approximately 65 to 75 percent of its rated speed to be a really efficient machine. At great depths switching over to the smaller sprocket will improve electrical operation and will not cause any appreciable drop in hoisting speed.

Clutching action is faster with electric drive than with steam due to quicker response to the easier reversed throttle. In a well balanced d-c. rig the rising empty block and hook have better "coasting action" because of the superior inertia action of the spinning heavy motor armature. All drawworks control operations are very smooth, and in general, the greater the number of drum throttle resistance taps the smoother the control accomplished.

Current for a dual drawworks drive can be provided efficiently by:

1. Paralleled-off single large generator.
2. Paralleled-off two smaller generators.

The second setup offers the safety method of operating, the control of the twinned generators being obtained by balancing their fields and connecting them in series off a single controller that will insure both fields creating fluxes of the same magnetic strength. Too much difficulty usually results in using two mechanically synchronized controllers, because they get out of adjustment, and the load cannot be evenly distributed. The motor fields should be balanced and paralleled off one of the exciter buses, but separate wiring should be used to each field from the control cabinets. Separate wiring prevents loss of control of motors if wires to one field become parted between motor and power plant.

The advantages of equipment that will generate high voltages without compounding shows up most plainly in the performance of hoisting operations. The machines of higher voltage not only are able to walk off with the higher torque loads, but their voltage characteristics impart a speed and snappiness to the rig.

Separate Rotary Drives

One prime disadvantage of the usual three-speed drawworks is that the sprockets spool constantly because all three clutches are on the drumshaft and these parts must move along with the rotary drive sprocket. The use of a separate drive rotary not only halts this action, but a sprocket can be so aligned on the rotary pinion shaft as to serve as an emergency drawworks drive.

Some advantages of separate rotary drives on electrical rigs are as follows:

1. No drawworks sprocket spooling and consequent wear.
2. Emergency means of drawworks operation.
3. Faster and smoother drawworks.
4. Trip saving time from above cause.
5. Use of usual drumshaft rotary spool sprocket as coring reel drive with reel in front of drum.
6. No rotary chain needed.
7. Less crowded floor.
8. Less noise.
9. Smoother kelly action and better drilling and coring actions.
10. Less vibration and longer rotary life.
11. Better overload torque control to prevent twistoffs.
12. More efficient than drawworks drive of rotary.
13. Easier to "drill up."
14. Flexible power cables greatly simplify rathole drilling operation.

The disadvantages of separate drive for rotary are as follows:

1. Initial additional cost.
2. Extra motor and control maintenance cost.

Rotary Motors

Rotary drive motors should be of at least 200 hp. and preferably of 1000 r.p.m. at 350 volts. Reduction with integral two-speed reduction gear (ratio 1:1 and 1:54) gives a tremendous torque output along with a top speed of about 250 r.p.m. with a 4 to 1 rotary pinion-ring gear ratio. This rotative speed may be overrun somewhat in surface hole, when the machine is lightly loaded, without harm to the 350-volt motor. The rotary, reduction gear, and driving motor should be unitized upon a heavy I-beam skid, and provision made for protecting the motor from shock and dampness.

Electric drive rotaries build up high rotative inertia and are by nature a machine less adaptable than steam rotaries to sudden changes in drill-pipe freedom. It is possible to run the rotary at any desired speed, but if the drill pipe becomes slowed or bound to any great degree, the torque (amperages) climbs almost instantaneously to a dangerous value. Unless protection is provided against such tremendous torque surges the drill pipe may be twisted off before the rotary can be stopped. The simplest protective method is to limit the torque that the rotary can develop during normal operations, but to have the full power available for emergencies.

If the rotary is driven separately by its own motor-generator set, the maximum torque can be best fixed by use of a controller actuated by an armature shunt of the rotary motor. The controller serves as a relay to a circuit breaker within the rotary power generator field circuit. The generator field strength could also be limited by using additional resistance in the field circuit when rotating, but such control is less effective, as it only limits, rather than interrupts, the current surge.

If the rotary is driven by the drawworks motor, the first method described heretofore could be used with provision being arranged to lock the controller when the pipe is to be withdrawn from the hole. Limitation of generator field by additional resistances could also be

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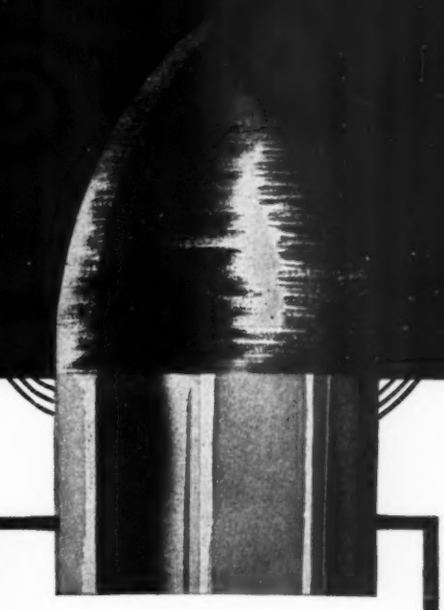

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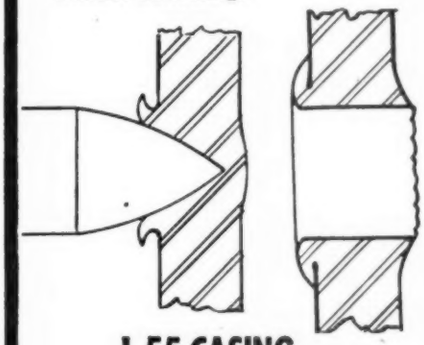

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used if the rotary is driven through the drawworks, and the action could be made semi-automatic by using the rotary clutch yoke motion to increase or reduce the permanent resistance in the field.

Throttles—Drum Controllers

All throttle wheels, together with respective stop buttons, may be mounted upon a heavy, vertical steel plate attached to the drawworks frame at the driller's position. Correct spacing will enable four throttles to be so placed, and the use of complicated dual and geared throttles is not recommended due to the frequent mechanical troubles experienced with such installations.

Manufacturer "B" makes a very bulky derrick floor control setup, that of Manufacturer "C" is more compact, whereas Manufacturer "A" has the lightest and most compact. As Manufacturer "A" uses only six control wires per generator-motor unit the "A" circuit is easier to install and maintain.

It is also possible to unitize small drum controllers so that up to four of them may be carried on a light unitized skid. The drum control units should be made quickly demountable, so that if necessary the drum controls and the base may be carried manually in emergencies.

Most of the factory built controllers are not designed for oil-field usage, and the heavy permanent controllers built originally for permanent installation in industrial plants provide a real problem in spacing and handling. The lighter drum type controller that does not need integral floor resistance elements may be mounted in a much smaller space, so that the staggered arrangement of the multiple controls will not interfere with the freedom of action of the throttle extension handles.

It is possible to mount up to three drum controllers upon the rear of the drawworks frame. When this is done, the drum controls have very short permanent throttle extensions, and are protected by steel plates.

Safety Switches

Within control cabinets either fuses or circuit breakers are used in order to keep individual circuit overload from interrupting general operations. This protection is sufficient for the simple accessory units but much more complicated instruments are needed to conduct and insure safe operation of the generator fields and blower motors.

There is no end to the amount of protective control that may be used in protecting the continuity of the more important circuits, and protective automatic control reaches a certain optimum maximum beyond which the trouble due to the complexity is greater than the true protection obtained. It is easy to include such protective devices as flashing lights, ringing bells, field interruptions. The more permanent the rig installation is to be, the more this practice may be followed.

All engine-generator units should have separate stop buttons, and several installations of these stop buttons should be placed around the rig. The driller should have a complete set at his position, and another set should be installed close to the slush pumps. Stop buttons are simple switches that open generator fields by one of two methods:

1. Are in series circuit with solenoid coils of generator field contactor, and open this circuit.
2. Actuate relays that accomplish the above action.

After interruption of a generator field circuit by a stop button, it is neccessary to zero the throttle in order to resume operations again. Until this precaution causes the contactors to pick up and complete the field circuit, power generator excitation is not possible. When the throttle is zeroed, the contactor coils are energized sufficiently to close the contactor, and until the curcuit is again broken, the coils are actuated by the flowing field current.

It would be possible to construct a radio-controlled type of Ward-Leonard control that could function without derrick floor control wiring, but under average field working conditions it would be difficult to maintain.

Wiring

Large single armature cables were used in standard practice for many years but single cables of the size necessary for heavy-duty drilling are too stiff to handle easily. Lately up to three cables of 500,000 circular mil rating have been single lugged for heavy-duty armature service, and have proved very satisfactory. Not only are single sections of such cables repaired more easily and economically, but the cables can be reeled much easier. Single leads of this size cable will suffice for water pump and accessory motors of like size.

Many interesting types of multiple cables and plugs have been used for control wiring, but these complicated attachments cannot stand up very long under average field conditions. The majority of field electricians prefer No. 8 or 10, flexible, solid, well-insulated, copper control wire for these circuits, the wires of each unit being taped or bound at 3-ft. intervals for convenience in handling. Using this practice, wiring troubles not only are more easily found, but they can be repaired much faster. The field wiring of the motors and the accessory wiring should be of the same approximate size in order to standardize as much as possible.

Exciter leads and armature connections should be of single 250,000 c.m. or slightly smaller cable depending upon the exciter rating. This size cable is to be used in the leads that enable the exciters to be paralleled, and to any small accessory motors about the rig.

Most of the standard wire doping compounds dry to a hard rigid surface that is very satisfactory on coils, terminals, and leads that do not undergo flexing. A heavy non-asphalt dope that does not dry out and crack is recommended for all flexible leads exposed to the elements.

Old wooden wire-line reels are very handy and efficient in storing and transporting of armature leads and wiring, and if spools of this nature are not used steadily upon rig moves, rapid cable and wire deterioration will result.

Care and Maintenance

Constant inspection of all electrical units should take place while running, and an hourly report should be made in detail upon the condition of all electrical phases of operations. At intervals of two or more years, all large electrical rotative units should be shop inspected, adjusted, and redoped. Canvas covers should be used to protect the large units from rodents and insects when the rig is shut down for any long period of time. In salt water areas, quicker deterioration of electrical equipment takes place, and additional care is necessary.

In salty and humid areas, contactor trouble results from the forming of oxides upon contactor points, the copper oxide being a nonconductor. The resulting arc and heating is very detrimental to contactor points and springs, and may be avoided by the use of silver points.

Personnel

An electrical rig not only needs a competent electrician - motorman in charge, but he should also have supervision over exceptionally experienced and intelligent motormen. Frequent changing of operating personnel should be avoided because it is necessary to develop an active interest on the part of the motormen. A large electric rig is a large investment and some factory education or coaching of rig engineers is advisable.

The more complicated mechanism of electric rigs demands much more careful and intelligent handling than the usual steam rig. Experience has shown that only the young drillers and toolpushers are interested enough to learn the proper use and limitations of electric power. A drilling superintendent for electric rigs must have a combination of experience, intelligence, and interest and he must either know electrical equipment or be willing to rely on the judgment of a competent engineer.

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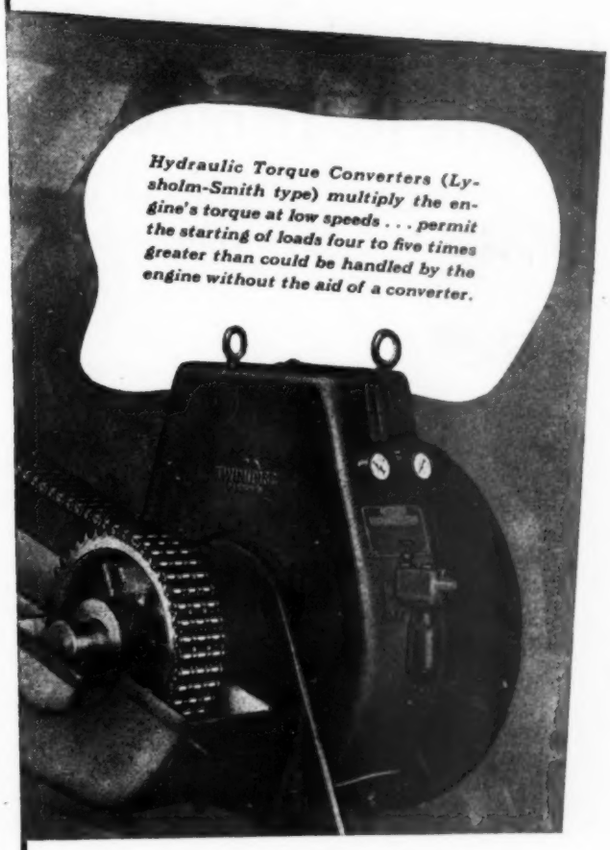
Hydraulic Torque Converters (Lysholm-Smith type) multiply the engine's torque at low speeds . . . permit the starting of loads four to five times greater than could be handled by the engine without the aid of a converter.

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Any load, when suddenly applied, is a shock-load to an internal combustion engine or a mechanical transmission. If the load is too heavy, it stalls the engine but even a moderate shock-load, if repeatedly applied, puts a heavy strain on all working parts. Metal-to-metal contact provides no cushion to ease the shock and, eventually, a break will occur at the point where the metal is unable to take this constant pounding.

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Chemical Treatment of Wells in Trinidad

☆ Methods used to remove mud from producing formation, perforations, and screens

by S. P. King, Production Superintendent,
Trinidad Consolidated Oilfields, Ltd., Fyzabad, Trinidad, B. W. I.

CHEMICAL treatment as a method of removing mud left on the face or in the producing formation during drilling operations, and as a means of cleaning perforations or screens to stimulate production, is today an established production practice in many sand fields. Service companies have developed equipment, chemicals, and personnel to such an extent that very few mud conditions fail to respond to treatment. Anticipating the use of this service, many operators "drill in" with special muds that will completely dissolve or disintegrate when treated with a certain chemical solution. Many operators in foreign countries are compelled, however, to forego these service company facilities either because they are not available or because the clean-out is so marginal financially as not to warrant the cost of the service. Under these conditions, there arises the necessity for a simple and economical method of chemically treating wells, utilizing ordinary available production equipment and chemicals easily procured by the operator. Several such methods used in Trinidad, British West Indies, are described in this article.

The conditions necessitating chemical treatment are varied, but generally come under one of two main classifications. The first group is concerned primarily with removal of mud cake at the time of completion. The disintegration of the mud sheath is incomplete and in isolated cases completely unaffected by ordinary washing because of one or more of the following reasons: (1) Poor colloidal properties of the mud used when drilling in resulting in a thick, tough cake; (2) support added to the mud sheath by perforated pipe; (3) failure of formation pressures to effect a breakdown of the mud cake, and (4) rupture of the mud sheath opposite one or more of the higher pressured sands.

It is difficult to associate one mud condition with a specific cause. One well in this locality was washed to water, then bailed to bottom without any indication of pressure. The records were checked and it was noted that although the condition of the mud at the time of drilling in was not ideal, it was not considered capable of giving much trouble. Correlation of the well's electric log with that of surrounding wells indicated a formation pressure ordinarily capable of inducing flow before the well was washed to water. While closed in awaiting facilities, this well suddenly built up a pressure of 380 lb. per sq. in. on the tubing and 760 lb. per sq. in. on the casing, and upon being put on production produced 110 bbl. per day on an 8/32 in. bean. Considerable mud was produced during the first 36 hours. A pressure survey revealed a bottom hole pressure of 960 lb. per sq. in.

S. P. KING

is a graduate of St. Mary's Boys' School, Calgary, Alberta, Canada—Received a B.E. degree in petroleum engineering from the University of Southern California in June, 1941—At various times previously, mostly during summer vacations, he had worked for the Wilshire Oil Company, Norwalk, California; Royalite Oil Company, Turner Valley field, Alberta, Canada, and Lane-Wells Company in the Turner Valley field and western Canada wildcat areas—Upon completion of his university work he joined the staff of Dowell Incorporated at Turner Valley, later relinquishing that post to accept a position as petroleum engineer with Trinidad Leaseholds, Ltd., Forest Reserve, British West Indies—Recently he became production superintendent for Trinidad Consolidated Oilfields, Ltd., Fyzabad, Trinidad, B. W. I.

The second group included conditions that caused a decrease in production after varying periods following completion. The decrease was attributed to one or both of the following reasons: (1) Clogging of the perforations or of the drainage area within a few feet of the well bore by "dirty" materials in the unconsolidated sands from which the wells produce. A study of well cores indicated that silt, clay, and colloidal clay formed 30 percent of the average producing sand. The producing zone near the well bore, being the point of convergence of flow from a considerable radius, was apparently packed in by these "dirty" materials, which were being continually washed toward the well bore and concentrated in this vital area by the increased velocity of flow. (2) Continuous sand production caused the interstratified shale beds to cave against the perforations, sealing them off.

Diagnosing Production Decline

It is, perhaps, pertinent to discuss briefly methods of differentiating between normal production decline and decrease in production due to clogging of the perforations or the formation immediately behind them. Failure to diagnose correctly the decline may result in useless clean-out work or premature installation of artificial lift. The best and most accessible criterions are records of the trend of production, productivity index, and static bottom hole measurement. If the production falls abnormally below the average of the surrounding wells despite normal periodic clean-outs, it is assumed that the perforated pipe or the formation is partially clogged. The productivity-index decline is more or less a check on the effective permeability of the producing sand. Changes will occur because of new values of viscosity, gas-oil ratio, or water cut. These are, however, gradual changes and usually follow a definite trend. Blinding of the perforations or formation behind them will cause the actual effective permeability to decrease considerably. A clean-out is indicated when any change in productivity can-

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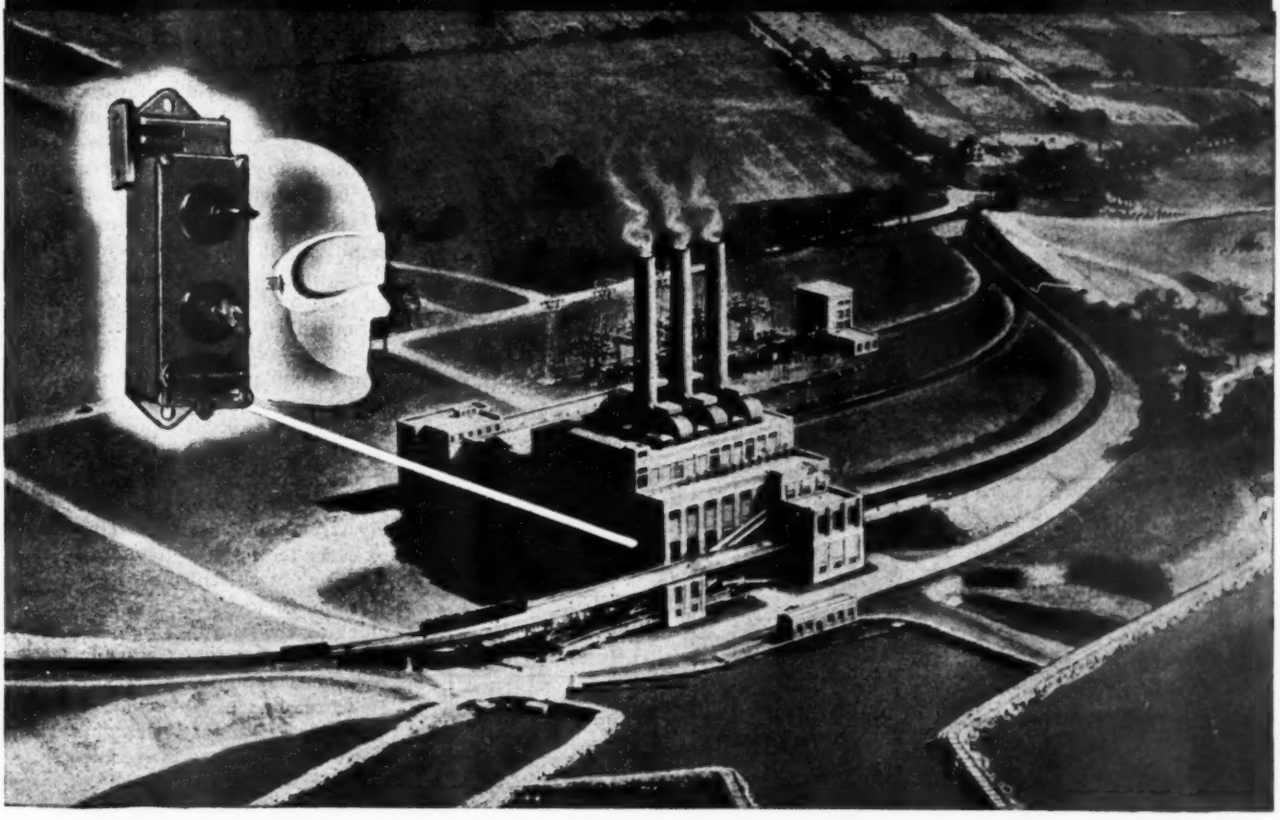

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not be explained by a corresponding change in viscosity, gas-oil ratio, or water cut. An investigation along these lines made on four wells in the same sand unearthed the following information. One well cored had an average dry-core permeability of 1.15 darcys. Upon completion, the mean effective permeability of the four wells was averaged at 0.783 darcys. This figure was derived from the specific productivity indices[1]. For an almost equal cumulative production, three of the wells showed a decline to 0.697 darcys whereas the fourth well dropped to 0.46 darcys. None of the wells was cutting water, viscosity values showed very little change, and the gas-oil ratios had increased almost equally. The added resistance to flow in the case of the fourth well was attributed to partially plugged perforations. After treatment, production for this well increased 14 percent and the mean effective permeability, calculated from the specific productivity index, was restored to 0.64 darcys. If periodic build-up curves are obtained from producing wells, a study of these will usually enable the operator to detect plugged perforations or formation. When shut in, the wells in this survey, if not affected by plugged perforations, showed an abrupt rise of approximately 70 percent of final pressure in 24 hours, then gradually leveled off. When the perforations became plugged, the abrupt rise, comprising approximately 25 to 45 percent of the ultimate pressure, lasted only for 10 to 15 hours and the rest of the increase was at an almost constant rate.

Experiments with cores and bailer samples showed that a solution of quebracho and caustic soda gave the most economical and beneficial results of any of the tested solutions. Hexneta phosphate and quebracho-tetra sodium pryophosphate mixtures were very effective but the phosphates were not readily obtainable. Chemical treatment was, as a general rule, only resorted to when ordinary clean-out facilities, including hydraulic bailers, failed; and in most cases was used in conjunction with a perforation washer. The solution was first made up in 42 gal. drums, 25 lb. of quebracho and 15 lb. caustic soda thoroughly dissolved in soft (rain) water. These drums could be easily stocked and transported, and facilitated mixing to any desired strength at the well site. The solution was particularly effective in deflocculating drilling mud sheaths, soft formation clay sludges, and in removing cement-mud mixtures.

[1]"Core-Analysis Interpretation," by Norris Johnston, *A.P.I., Drilling and Production Practice*, 1941.

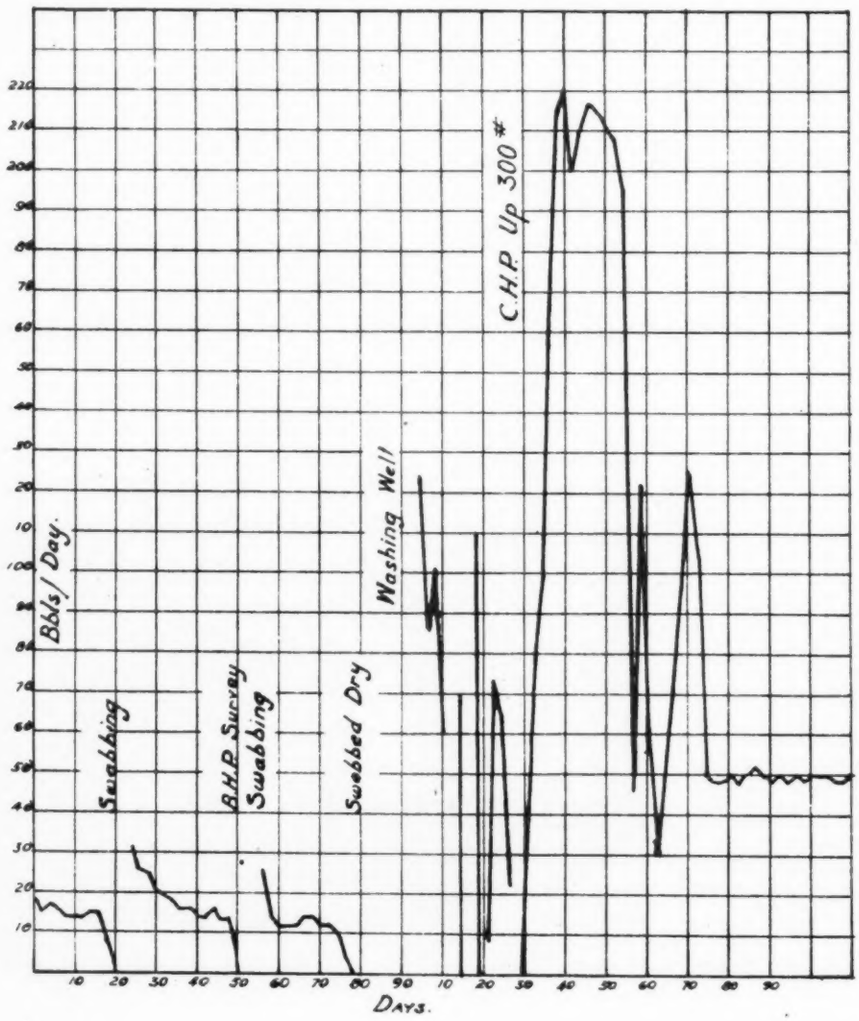

Fig. 1

Administering Treatment

Unless applied during completion of new wells, chemical treatment was administered with ordinary production equipment used in "washing down." The solution was mixed in a 25 bbl. tank and spotted by a 10 by 5½ by 10 pump via Chiksan hose, Chiksan circulating head and tubing at the desired depth. To facilitate raising and lowering of tubing while washing, a small production type blowout preventer was included as standard equipment.

The technique was also more or less standardized. The well was first washed to bottom, displacing well fluid with a solution made of 1 bbl. of prepared solution to 20 bbl. of water. A 5½ in. tubing shoe bit was invariably used to insure consequent safe running of the perforation washer. The solution was circulated steadily from the bottom until returns were reasonably clean, then the casinghead valve or fill-up valve on the blowout preventer was closed during circulation approximately two out of every ten minutes to effect a "backwashing" of the entire formation in an attempt to loosen "dirty" materials clogging the sand face immediately behind the perforations. This process was continued so long as returns showed evidence of successful removal of mud, sand, etc. This stage, thought to have the twofold effect of forcing fresh chemical behind the pipe and of bringing the disintegrated material into the hole, was found very effective and often wells would show increased life after several hours' treatment. Some operators achieved the same effect by down-and-up swabbing. When clean returns indicated completion of this phase, a stronger solution (1 bbl. prepared solution to 10 bbl. water) was spotted opposite the producing interval and left to "pickle" for 24 hours. Tubing would then be pulled and a simple shop-made perforation washer of the pressure type substituted for the tubing shoe bit. The perforations were then thoroughly washed and every perforated interval subjected to another wash-back action in which approximately 1 bbl. was squeezed into every 10 ft. of perforations. After pulling the washer to the top of the perforations, the well would be closed in for 24 hours. A second perforation washing was the next step, and

your silent partner

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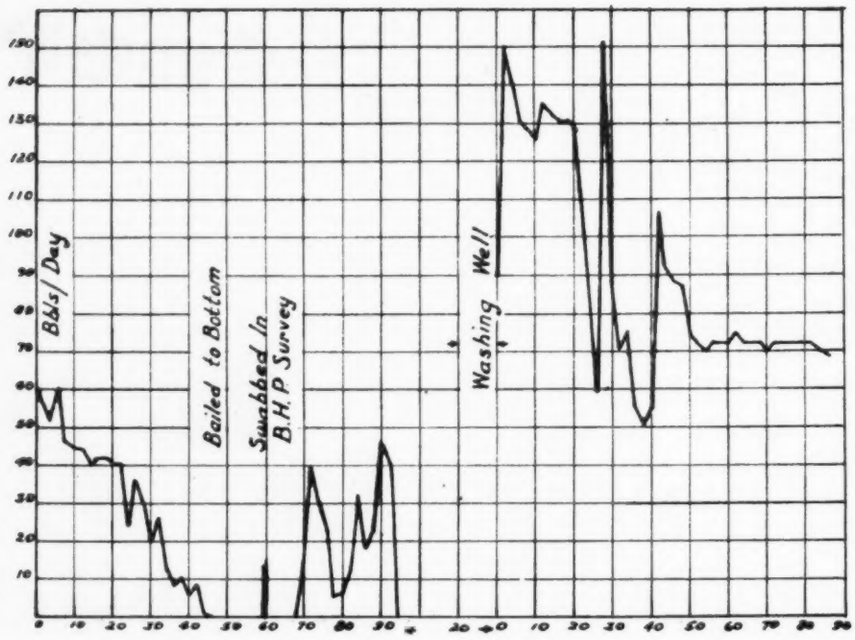

Fig. 2

it was generally noted that this washing was far more effective than the first in removing "dirty" material. Upon recompletion of the well, it was frequently advantageous to lubricate periodically some of the solution into the casing to soften up "dirty" materials being produced through tubing for the first few days. If the well was recompleted by swabbing, this phase was almost essential as it was noted that the swab tended to pull in mud faster than the solution could soften it. Consequently, it was frequently found necessary to bail inside 2 in. tubing to remove thick shale plugs before reverting to swabbing. In the writer's opinion, circulation of gasified oil or the use of a compressor is the ideal method of putting a well back on production after treatment. It can readily be seen from Figs. 1, 2, and 3 that following treatment, the amount of "dirty" material and oil produced fluctuated greatly for a certain "clean-out" period before the wells cleaned up and settled down to a steady daily production.

Results

Figs. 1, 2, and 3 graphically illustrate the beneficial results of chemical treatment. Fig. 1 is an example of premature installation of artificial lift equipment. This well, despite periodic clean-outs, was continually loading-up; it was therefore relegated to pumping and surface equipment installed. An analysis of build-up curves prepared for the purpose of designing the subsurface installation, revealed all symptoms of blinded perforations. The well was therefore treated as described and recompleted as a comparatively steady flowing producer. Fig. 2 is an example of a well that showed an abrupt decline and the change in productivity could not be explained by new values of gas-oil ratio, viscosity, or water-cut. The decrease was therefore attributed to plugged perforations and the well was successfully treated for such. The well in Fig. 3 was put on gas-lift soon after completion. A comparison with similar neighboring low pressure wells suggested the possibility of selective rupture of the highest pressured sand upon initial completion. That is to say, when the well was being swabbed into production, all the perforations were mudded off. As the fluid level dropped with the swabbing, the pressure differential across the perforations of the highest pressured sand was increased until it finally ruptured the mud sheath. The well began to flow and was then beaned at the surface, thus retaining a bottom-hole pressure sufficient to prevent low pressure intervals from cleaning their perforations. The well soon ceased flowing due to a deficiency of gas and was subsequently equipped with flow valves and produced with a high fluid level to curtail sand production.

Upon being chemically treated, the perforation washer actually stalled in two of the perforated intervals, which upon being cleared, produced sufficient gas and of adequate pressure to keep the well flowing by heads. Although the increase in production was slight, the production cost per barrel was considerably reduced and the flow valves were released for service elsewhere.

Beneficial results from this technique can be expected only when conditions causing loss of production are capable of reacting to the treatment. The fundamental permeability of the formation cannot be increased, nor can scale deposits or substances that are not effectively broken down by the chemical, be removed from the perforations or sand face. The type of plugging agent must first be determined and then treated with available chemicals to ascertain which, if any, can successfully cope with it. Particular care should be taken to make sure that the reaction is not productive of any organic sludges or precipitates that might aggravate instead of alleviate the condition. Once the solution itself has been chosen, the method of treatment must be considered. The time the solution is to be kept in contact with the plugging agent is important, also a means of mechanically agitating the solution to keep fresh chemicals in contact with substances to be removed. The actual procedure, however, can best be determined by experimentation and careful recording of all treatments.

The payout of this chemical reconditioning work was 10 days for Fig. 1, 12 days for Fig. 2, and 87 days for Fig. 3. The average for 10 jobs was 17 days. Although the mud condition necessitating chemical clean-out was, in the majority of cases, recurrent, the payout time was generally very satisfactory. Many of the wells require servicing about every 90 days, but the sagging decline curve is usually re-established to such an extent that the payout is achieved in less than 15 days.

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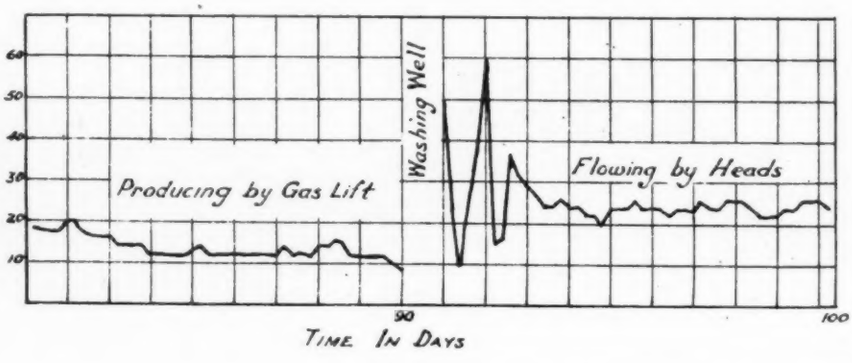

Fig. 3

Scene from Warner Bros. Picture "Air Force"

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by V. W. Palen

Westinghouse Electric and Manufacturing Company

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$$\text{Kva.} = \frac{\text{Volts} \times \text{amp.}}{1000}$$

$$\text{Kw.} = \frac{\text{Volts} \times \text{amp.} \times \text{P.F.}}{1000}$$

$$\text{Hp.} = \frac{\text{Volts} \times \text{amp.} \times \text{P.F.}}{746}$$

(b) Three phase

$$\text{Kva.} = \frac{\sqrt{3}\ \text{volts} \times \text{amp.}}{1000}$$

$$\text{Kw.} = \frac{\sqrt{3}\ \text{volts} \times \text{amp.} \times \text{P.F.}}{1000}$$

$$\text{Hp.} = \frac{\sqrt{3}\ \text{volts} \times \text{amp.} \times \text{P.F.}}{746}$$

The range of the calculator 5 to 200 (kilovolt-amperes, kilowatts, or horsepower as the case may be) can be extended easily to cover a range of 50 to 2000 merely by multiplying all values by 10. It can be used to find kilovolt-amperes, kilowatts, or horsepower from known values of amperes and volts; similarly it will determine amperes for given values of voltage, kilovolt-amperes, kilowatts, or horsepower. Thus, knowing the size motor to be installed, an electrician can quickly determine amperes—from this he knows what size wire to use for the circuit. Conversely, having read amperes at transformer terminals, the calculator tells what load, in kilovolt-amperes the transformer is carrying.

To assemble, cut out both disks (also small windows) and mount on cardboard with rubber cement. Punch the center holes carefully, then insert a small brass bolt in the holes. Washers, if used, will save wear and tear on the paper. The bolt should be tightened to give the proper pressure on the disks—they must hold their setting, yet turn easily. A drop of solder applied to the nut will make the assembly permanent.

V. W. PALEN

was graduated in 1925 from the University of Wisconsin with a B.S. degree in electrical engineering—From 1925 to 1942 he occupied various engineering positions with the following companies: New York and Queens Electric Light and Power Company; Bell Telephone Laboratories, New York City; National Electric Light Association (now Edison Electric Institute); Metropolitan Edison Company, Reading, Pennsylvania, and Northern States Power Company, in Wisconsin—Joined Westinghouse Editorial Service Department, East Pittsburgh, Pennsylvania, in 1942.

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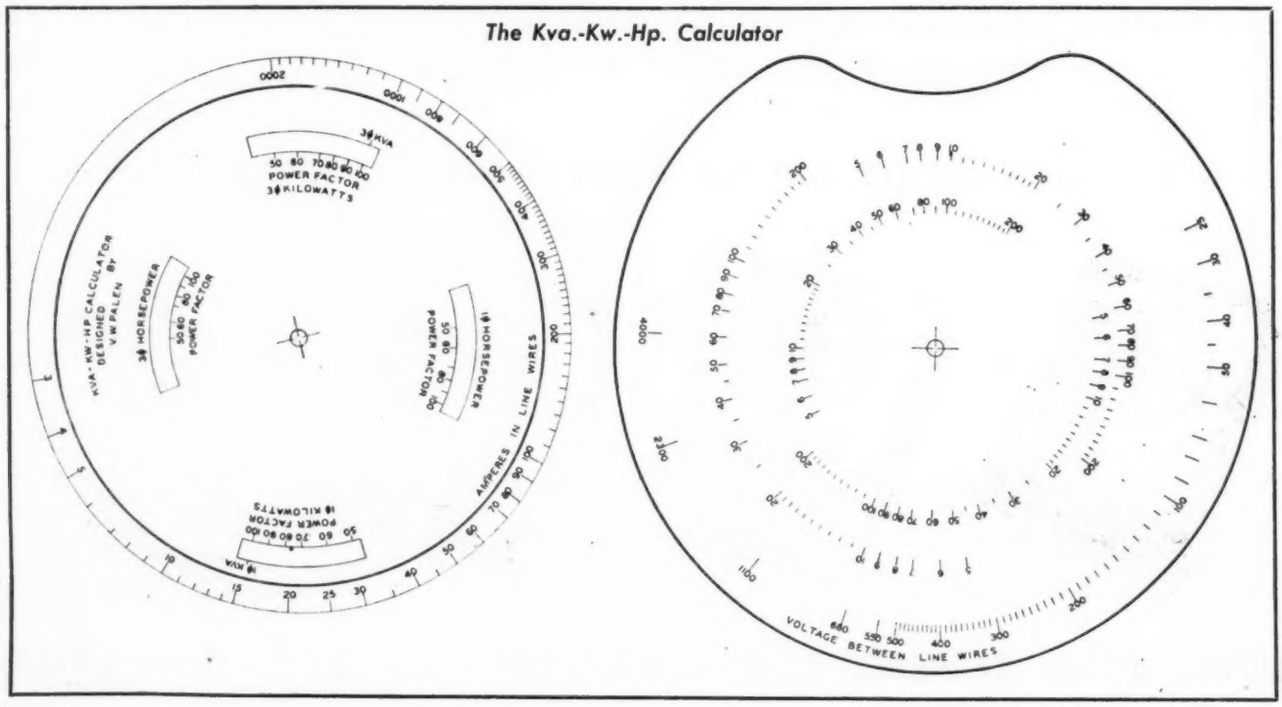
The Kva.-Kw.-Hp. Calculator



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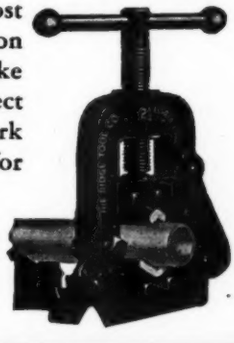

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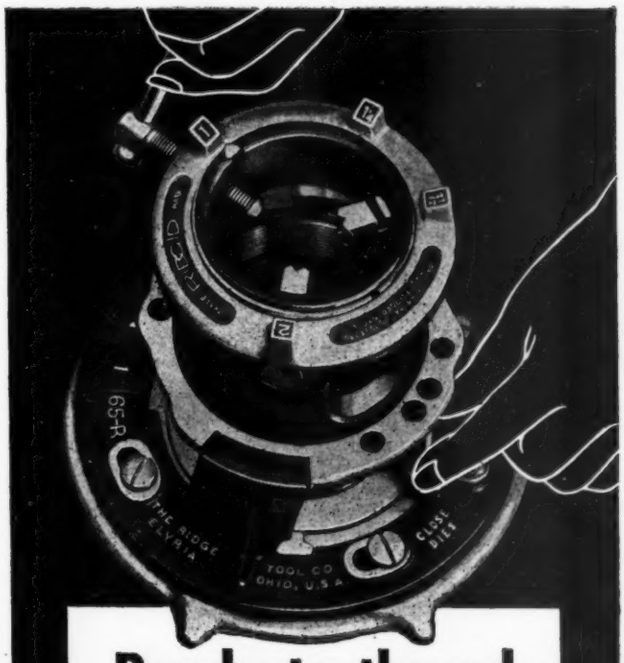

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Graphic Solution of Natural Gas Pipe Line Flow

☆ Presentation of method and calculation of charts

by Griffith H. McKay, War Production Board

and

P. McDonald Biddison, Consulting Engineer

THE purpose of this article is to present a rapid method for the solution of problems in natural gas transmission by means of charts. An equation for the friction factor is presented, however the method is not tied to that equation; it may be used as readily with any equation of that type found suitable for the problem. In fact, it may be readily adapted to problems in the flow of liquids.

GRIFFITH H. McKAY

is consulting engineer for the Office of War Utilities of the War Production Board, resigning a position on the general engineering staff of the Arkansas Natural Gas Corporation to become affiliated with that body—He received a bachelor's degree in civil engineering from Mississippi State College in 1930—After graduation he was employed by Arkansas Natural and placed in its Junior Engineer Training Course, receiving office and field training in the various phases of the company's operations—Later was on the general engineering staff.

$$Q = 38.7744 \times \frac{T_o}{P_o} \times d^{2.5} \times \frac{1}{\sqrt{f}} \times \sqrt{\frac{P_1^2 - P_2^2}{GTL}} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The value of the friction factor $\frac{1}{\sqrt{f}}$ can be expressed as:

$$\frac{1}{\sqrt{f}} = a \log R\sqrt{f} + b \quad . \quad . \quad . \quad (1a)$$

In equation (1a) the values of the constants a and b have been fixed by various investigators for various conditions of the pipe wall. Three sets are presented here:

Value of	a	b
Smooth pipe, Nikuradse	4.0	—0.4
Commercial pipe, Drew and Genereaux	3.2	1.2
Large natural gas pipe line, Biddison	3.6	—0.1

The expression for the friction factor to be used in this discussion will be derived from the equation suggested by Biddison:

$$\frac{1}{\sqrt{f}} = 3.6 \log R\sqrt{f} - 0.1 \quad . \quad . \quad (2)$$

This relationship can be closely approximated over a considerable range in Reynold's number by a power equation in the form:

$$\frac{1}{\sqrt{f}} = mR^n \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

This in turn may be expressed:

$$\log \frac{1}{\sqrt{f}} = \log m + n \log R \quad . \quad (4)$$

Assume that equations (2) and (4) are to be coincident at the two values of $\frac{1}{\sqrt{f}}$ of 17.0 and 20.5.

By calculation from equation (2) these correspond respectively to values of R of 955,988 and 10,813,000

$$\frac{1}{\sqrt{f}} = 3.6 \log R\sqrt{f} - 0.1$$

$$\left(\frac{1}{\sqrt{f}} + 0.1\right) \div 3.6 = \log R\sqrt{f}$$

$$0.277778 \times \frac{1}{\sqrt{f}} + 0.0277778 + \log \frac{1}{\sqrt{f}} = \log R.$$

Substituting 17.0 for $\frac{1}{\sqrt{f}}$

$$\log R = 0.277778 \times 17.0 + 0.027778 + 1.2304489$$

$$\log R = 5.9804527$$

$$R = 955,988.$$

Substituting 20.5 for $\frac{1}{\sqrt{f}}$

$$\log R = 0.277778 \times 20.5 + 0.027778 + 1.3117539$$

$$\log R = 7.0339807$$

$$R = 10,813,800.$$

Substituting each set of values in equation (4):

$$\log 17.0 = \log M + N \log 955,988 \quad . \quad . \quad (5)$$

P. McDONALD BIDDISON

recently opened an office in Chicago as consulting engineer—Previously he had been affiliated with the War Production Board and prior to that had operated since 1927 as a consulting engineer, making his headquarters in Dallas, Texas—He graduated in 1904 from Kansas State College of Agriculture and Applied Science with the degree of bachelor of science in electrical engineering—Followed association with a number of gas and engineering companies until he entered consulting work—He is a licensed professional engineer in the states of Texas and Oklahoma.

$$\log 20.5 = \log M + N \log 10,813,800 \quad . \quad (6)$$

Substituting the logarithms

$$1.2304489 = \log M + N \times 5.9804527 \quad . \quad . \quad (7)$$

$$1.3117539 = \log M + N \times 7.0339807 \quad . \quad . \quad (8)$$

Subtracting

$$0.081305 = N + 1.053528 \quad . \quad (9)$$

$$N = 0.077174 \quad . \quad . \quad . \quad (10)$$

FOR export drilling work—where elimination of every possible risk of equipment and manpower is demanded today—*choose your fishing tools carefully!* Be sure to look for the operating features that reduce fishing hazards to the core . . . insure greatest safety for men and equipment . . . and place maximum working effectiveness on the *fish* under all conditions.

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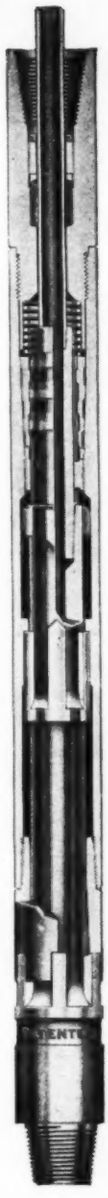

Here's a straight-pull Fishing Jar *(left)* that requires no dangerous torque for operation, yet is fully adjustable for intensity of blow while in the hole. It strikes as many as *ten* hard jarring blows per minute—average—to keep the fish moving once it's started.

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Substituting this value of N in equation (7):

$$1.2304489 = \log M + 0.077174 \times 5.9804527 \quad . \quad . \quad (11)$$

$$\log M = 0.7689134 \quad . \quad . \quad (12)$$

$$M = 5.87372 \quad . \quad . \quad . \quad (13)$$

Substituting this value of M and N in equation (3):

$$\frac{1}{\sqrt{f}} = 5.87372 \times R^{0.077174} \quad . \quad . \quad (14)$$

To test the divergence of the two equations the value of R is computed from assigned values of $\frac{1}{\sqrt{f}}$ for each equation as follows:

Value of $\frac{1}{\sqrt{f}}$	*Value of R*	
	Biddison Equation	*Equation (14)*
15.0	234,710	188,400
16.0	474,620	435,800
17.0 Coincident	955,980	955,980
18.0	1,918,900	2,005,000
19.0	3,839,800	4,039,000
20.0	7,662,400	7,852,800
20.5 Coincident	10,813,800	10,813,800
21.0	15,252,600	14,777,000
22.0	30,290,900	27,001,000
23.0	60,034,000	48,031,000
24.0	118,756,000	83,374,000

Although the comparison in the above table appears to indicate substantial divergence yet plotting of the two shows that between R = 200,000 and R = 60,000,000 the divergence is not material and only below R = 500,000 and above R = 20,000,000 is the divergence of such amount as to be readable on a log—log plotting of 5 in. per cycle. Within the usual range of gas transmission problems it is therefore as acceptable for use as is the Biddison equation.

For gases the Reynold's number is:

$$R = \frac{Q \times P_o \times G \times 477.36}{d \times T_o \times Z \times 10^6} \quad . \quad . \quad (15)$$

If the viscosity be taken as $\frac{7}{10^6}$ this becomes

$$R = \frac{Q \times P_o \times G \times 68.194}{d \times T_o} \quad . \quad . \quad (16)$$

Substitute the value of R in equation (14):

$$\frac{1}{\sqrt{f}} = 5.87372 \times \left(\frac{Q \times P_o \times G \times 68.194}{d \times T_o}\right)^{0.077174} \quad . \quad . \quad . \quad (17)$$

$$\frac{1}{\sqrt{f}} = 8.13637 \times \left(\frac{Q \times P_o \times G}{dT_o}\right)^{0.077174} \quad . \quad . \quad . \quad (18)$$

Substituting this value of the friction factor in equation (1):

$$Q = 38.7744 \times \frac{T_o}{P_o} \times d^{2.5} \times 8.13637 \left(\frac{QP_oG}{dT_o}\right)^{0.077174} \times \left(\frac{P_1^2 - P_2^2}{GTL}\right)^{0.5} \quad . \quad . \quad (19)$$

$$Q^{0.92286} = 315.4829 \left(\frac{T_o}{P_o}\right)^{0.92286} \times \frac{d^{2.422826}}{G^{0.422826}} \times \left(\frac{P_1^2 - P_2^2}{TL}\right)^{0.5} \quad . \quad . \quad . \quad (20)$$

Squaring equation (20):

$$Q^{1.845652} = 99529.5 \left(\frac{T_o}{P_o}\right)^{1.845652} \times \frac{d^{4.845652}}{G^{0.845652}} \times \left(\frac{P_1^2 - P_2^2}{TL}\right) \quad . \quad . \quad . \quad (21)$$

$$\frac{P_1^2 - P_2^2}{L} = \frac{Q^{1.845652}}{99529.5} \frac{G^{0.845652}}{d^{4.845652}} \times \left(\frac{P_o}{T_o}\right)^{1.845652} \times T \quad . \quad . \quad . \quad . \quad (22)$$

Assuming as a measurement base for Q:

$P_o = 14.735$ lb. per sq. in.

$T_o = 60°$F. or 519.6° abs.

and using as a flowing temperature

$T = 60°$F. or 519.6° abs.

Then substituting the above in equation (22):

$$\frac{P_1^2 - P_2^2}{L} = \frac{Q^{1.845652}}{137434} \frac{G^{0.845652}}{d^{4.845652}} \quad . \quad . \quad (23)$$

$$Q = \left(\frac{P_1^2 - P_2^2}{L}\right)^{0.5418139} \times 607.984 \times \frac{d^{2.625442}}{G^{0.458186}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (24)$$

$$\frac{Q}{d^{2.625442}} \times G^{0.458186} = 607.984 \times \left(\frac{P_1^2 - P_2^2}{L}\right)^{0.5418139} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (25)$$

If we assume in the equation that G = 1.0 then the solution would give an incorrect value for the difference in squares per mile except for the specific case where the specific gravity of gas was actually 1.0. Making this assumption:

$$\frac{Q}{d^{2.625442}} = 607.984 \left(\frac{P_1^2 - P_2^2}{L}\right)_x^{0.5418139} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (26)$$

Division of equation (25) by equation (26) and extracting the root gives:

$$\left(\frac{P_1^2 - P_2^2}{L}\right) = \left(\frac{P_1^2 - P_2^2}{L}\right)_x \times G^{0.845652} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (27)$$

From equation (26) values of $\frac{Q}{d^{2.62544}}$ are computed for assumed values of $\left(\frac{P_1^2 - P_2^2}{L}\right)$ and the values of $\frac{Q}{d^{2.62544}}$ are plotted against the corresponding values of $\left(\frac{P_1^2 - P_2^2}{L}\right)$ on Fig. 1.

Values of $d^{2.62544}$ are obtainable from Fig. 2 and values of $G^{0.845652}$ are obtainable from Fig. 3.

If the problems usually to be solved involve a different pressure base, measurement base, or flowing temperature, it will be found more convenient to plot an equivalent Fig. 1 based upon these conditions and the computer is free to pick his equation of friction factor from others available or to derive it from available data that seems best to fit his conditions.

Example of solution for pressure:

Given: A flow of 8,500,000 cu. ft. per day through a line 20 in. O.D. with a wall thickness of ⅜ in., 36 miles long, specific gravity of 0.64, pressure base of 14.735 lb. per sq. in., flowing temperature 60°F., and an outlet pressure of 200 lb. gauge.

Solution:

1. From Fig. 2 for an inside diameter of 19.25 in. the value of $d^{2.625442}$ is 2400.

2. From Fig. 3 the value of $G^{0.845652}$ when G = 0.64 is 0.69.

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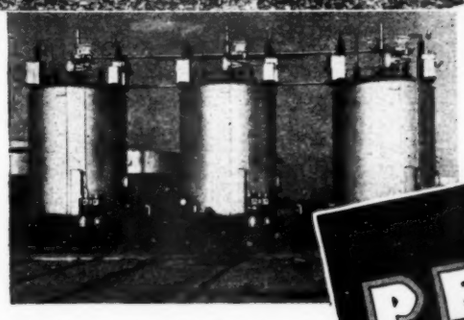

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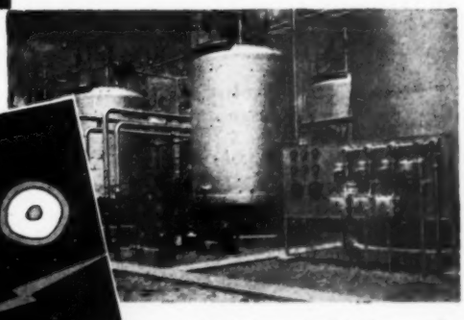

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COMPLETE REFINERY AND OIL FIELD SERVICES

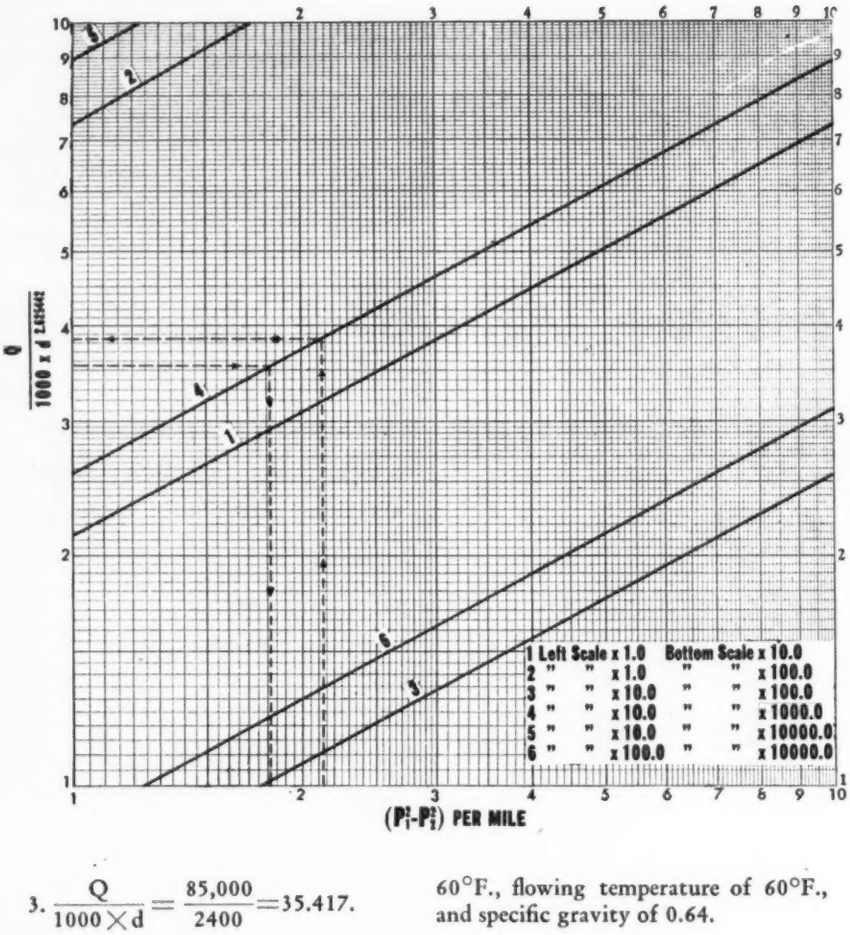

Fig. 1. Gas flow

Solution:

1. $P_1^2=(300+14.735)^2=99{,}058$
   $P_2^2=(200+14.735)^2=46{,}111$
   $(P_1^2-P_2^2)=52{,}947$

$$\left(\frac{P_1^2-P_2^2}{L}\right)=\frac{52{,}947}{36}=1471$$

2. This is the actual difference in squares per mile. To convert it into the quantity that would correspond to a specific gravity of 1.0 it is to be divided by $G^{0.845652}$, which is obtained from Fig. 3 and is 0.69.

3. $\frac{1471}{0.69}=2132$

4. On Fig. 1 for the difference in squares per mile the corresponding value of $\frac{Q}{1000\times d^{2.625442}}=38.5$

5. From Fig. 2 the diameter factor for 19.25 inside diameter is 2400.

6. $\frac{Q}{1000\times 2400}=38.5$

$Q=92{,}400{,}000$ cu. ft.

Change of measurement, base

3. $\frac{Q}{1000\times d}=\frac{85{,}000}{2400}=35.417.$

4. From Fig. 1 for this value on left scale we get difference in squares per mile on bottom scale to be 1825. This figure is our pseudo difference in squares and applies to a specific gravity of 1.0.

5. From Fig. 3 the correction factor to be applied for 0.64 gravity is 0.69.

6. $\left(\frac{P_1^2-P_2^2}{L}\right)=1825\times 0.69$

$(P_1^2-P_2^2)=1825\times 0.69\times 36$

$P_1^2-P_2^2=45{,}333$

$P_2^2=(200+14.735)^2=46{,}111$

$P_1^2=(287.7+14.735)^2=91{,}444$

Example of solution for quantity:

Given: A length of 36 miles of 20 in. O.D. by ⅜ in. pipe line with pressure of 300 lb. inlet and 200 lb. outlet pressure gauge with base pressure of 14.735 lb. per sq. in., base temperature of 60°F., flowing temperature of 60°F., and specific gravity of 0.64.

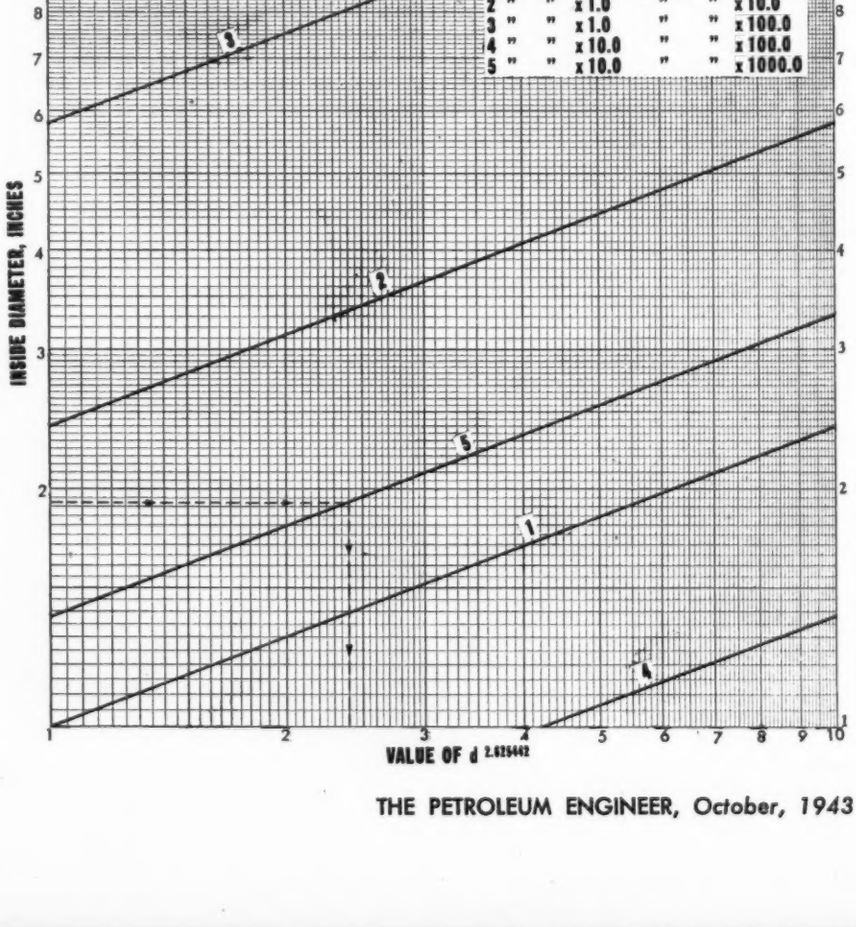
1 Left Scale x 1.0 Bottom Scale x 1.0
2 " " x 1.0 " " x 10.0
3 " " x 1.0 " " x 100.0
4 " " x 10.0 " " x 100.0
5 " " x 10.0 " " x 1000.0
INSIDE DIAMETER, INCHES
VALUE OF $d^{2.625442}$

Fig. 2. Diameter factor; value of $d^{2.625442}$

NEED MOTORS FOR *Hazardous Areas?*

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	Polyphase Squirrel-cage	Polyphase Wound-rotor	Single-phase	Direct-current
RANGE OF AVAILABLE * HORSEPOWER RATINGS				
CLASS I, GROUP C For atmospheres containing ethyl-ether vapor, etc.			1/20 to 1/3 hp	1/20 to 1/2 hp
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CLASS II, GROUP E For atmospheres containing metal dusts—magnesium, aluminum, etc.	1/8 to 75 hp	1/2 to 60 hp	1/20 to 10 hp	1/20 to 30 hp
CLASS II, GROUP F For atmospheres containing coal dust, coke dust, etc.	1/8 to 600 hp	1/2 to 250 hp	1/20 to 10 hp	1/20 to 30 hp
CLASS II, GROUP G For atmospheres containing grain dust, etc.	1/8 to 600 hp	1/2 to 250 hp	1/20 to 10 hp	1/20 to 30 hp

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TSG-216-8050

pressure or temperature. The solution from Fig. 1 is for quantity at 14.735 lb. per sq. in. and 60°F. If quantity be stated at another measurement base, convert that quantity to 14.735 lb. per sq. in. and 60°F. by multiplying by $\frac{P_o}{14.735} \times \frac{519.6}{T_o}$ before solving for difference in squares of pressure.

In solving for quantity, the quantity determined from Fig. 1 may be converted to any other measurement base by multiplying by $\frac{T_o}{519.6} \times \frac{14.735}{P_o}$

Change of flow temperature. The solution from Fig. 1 being based upon a flowing temperature of 60°F. a correction must be applied for any other flowing temperature.

It may be seen from equation (22) that difference in squares is proportional to T hence a value of $\frac{P_1^2 - P_2^2}{L}$ taken from Fig. 1 may be converted for any flowing temperature other than 60°F. by multiplying it by $\frac{T}{519.6}$.

From the same equation it may be derived that the quantity will vary inversely as the value of $T^{0.5418139}$ hence a quantity found from Fig. 1 may be converted to the quantity of flow for a flowing temperature other than 60°F. by multiplying it by $\left(\frac{519.6}{T}\right)^{0.5418139}$.

Appendix

In order to give the reader the data necessary for him to set up charts for his use, the appendix is included.

To lay out Fig. 1 for reading quantity from pressure factor or vice versa:

$T_o = 60°F.$ or 519.6 abs.

$P_o = 14.735$ lb. per sq. in.

$$\frac{Q}{d^{2.625442}} \times G^{0.458861} = 607.984 \left(\frac{P_1^2 - P_2^2}{L}\right)^{0.5418139}$$

Assume $G = 1.0$

$$\frac{Q}{d^{2.625442}} = 607.984 \left(\frac{P_1^2 - P_2^2}{L}\right)^{0.5418139}$$

$$0.5418139 \log \left(\frac{P_1^2 - P_2^2}{L}\right) x + \log 607.984 = \log \frac{Q}{d^{2.625442}}$$

1	2	3	4	5	6
Value of $\left(\frac{P_1^2 - P_2^2}{L}\right) x$	log Column (1)	0.5418139 × Column (2)	log 607.984	Column 3 + Column 4	$\frac{Q}{d^{2.625442}}$
10	1.000000	0.5418139	2.7838916	3.3257055	2116.93
80	1.903090	1.0311206	2.7838916	3.8150122	6531.50
100	2.000000	1.0836268	2.7838916	3.8675194	7370.88
800	2.903090	1.5729345	2.7838916	4.3568261	22794.30
1,000	3.000000	1.6254417	2.7838916	4.4093333	25664.50
8,000	3.903090	2.1147484	2.7838916	4.8986400	79184.50
10,000	4.000000	2.1672556	2.7838916	4.9511472	89360.80
80,000	4.90309	2.6565623	2.7838916	5.4404539	275711.00
100,000	5.000000	2.7090695	2.7838916	5.4929611	311144.00

To lay out Fig. 2 for reading values of $d^{2.625442}$ from d

$d^{2.625442} = 2.625442 \log d$

d	log d	2.625442 × log d	$d^{2.625442}$
1	0	0	1.0
2	0.301030	0.790337	6.1707
5	0.698970	1.836105	68.4080
10	1.000000	2.625442	422.1300
20	1.301030	3.415779	2604.8000
50	1.698970	4.460547	28876.0000
100	2.000000	5.250884	178190.0000

To lay out Fig. 3 for reading values of $G^{0.845652}$ from G.

$G^{0.845652} = 0.845652 \log G$.

Value of G	Log G	0.845652 log G	$G^{0.845652}$
0.10	9.000000-10	9.154348-10	0.1426
1.00	0.000000	0.000	1.0
10.00	1.000000	0.845652	7.0089

☆ ☆ ☆

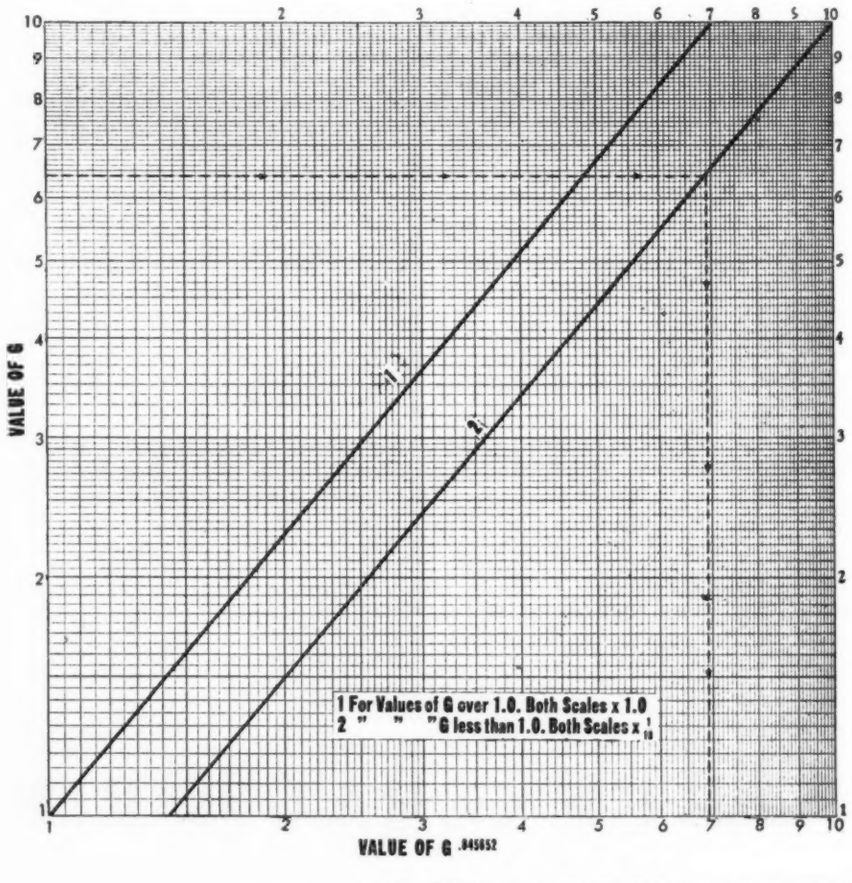

Fig. 3. Specific gravity factor. Values of $G^{0.845652}$

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Completion Methods in Eastern Venezuela

Exclusive

☆ Procedure similar to that of U. S., varying with local conditions

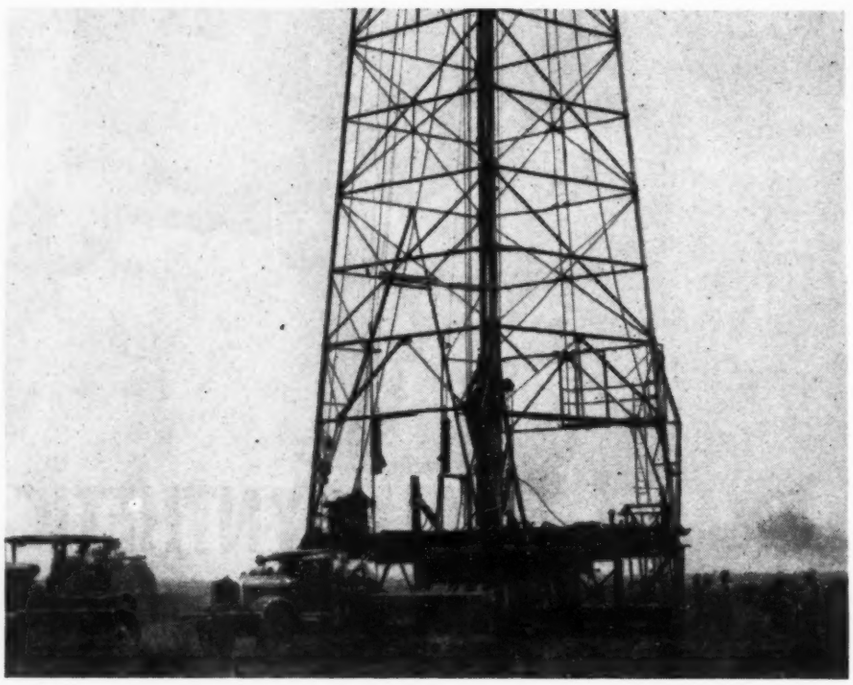
by Wallace A. Sawdon
Pacific Coast and Foreign Editor

METHODS of completing oil wells in Venezuela in general are similar to those used in the United States when local conditions are approximately the same. Completion practices followed in the Jusepin field in eastern Venezuela may be given as an example. During the early exploratory drilling period in this field it was found that more casing was used than was needed after the production drilling program was worked out and adapted to conditions as they were found to exist.

Surface casing set during the initial drilling period varied in diameter but the casing program followed when 18⅝ in., 78 lb. per ft., eight V-thread surface casing was used may be taken as a typical example. Setting depths of this string varied from 84 to 128 ft. An intermediate string of 13⅜ in., 61 lb. per ft., eight V-thread was set at depths ranging from 1500 to 1600 ft. Casing 9⅝ in., 47.6 lb. per ft. was then cemented on the top of the producing formation, and 4¾ in., 16 lb. per ft., ten V-thread per inch slotted liner was set and sealed to the 9⅝ in. casing. These liners varied in length from 126 ft. to 492 ft. and could be washed over and recovered if additional drilling or testing was found necessary or desirable.

After the drilling and completing conditions inherent in the field had been generally outlined by the preliminary program, the amount of casing used per well was reduced substantially. Under the development drilling program the following example may be taken as typical of the casing program used, although actual length of the strings will vary as local conditions require. Surface casing of 13⅜ in. diameter and weighing 48 lb. per ft. is now set at 61 ft. An intermediate string of 9⅝ in., 36 lb. per ft. casing is now set and cemented at 539 ft. The producing string of 4587 ft. of 5½ in., 15 lb. per ft. casing is set and cemented through the producing formation.

After the cement has set, the 5½ in. casing is gun perforated, usually with two holes per ft., opposite the producing formation.



Skidding derrick to new location after completing a well

Tubing of 2½ in. diameter and weighing 6.5 lb. per ft. is then run and the well brought in and produced through a choke to control the gas-oil ratio.

Some dual completions have been made in the field. Completion practice followed in these wells is similar to that for the single completion just outlined, except that the 5½ in. producing casing is gun perforated opposite two producing zones. A packer on the tubing is set between the two sets of perforations. Oil from the lower formation is produced through the tubing and that from the upper formation is produced up the annular space between the tubing and the casing.

The depths of the wells drilled to date in the field average approximately 4700 ft. and the time required to drill and complete them varies as controlling conditions change. Elapsed times, which may be considered within more or less normal limits, vary from 15 to 35 days. An analysis of the drilling time on two wells having approximately these completion times is given in Table 1.

TABLE I

Operation	*First well, time in days*	*Second well, time in days*
Moving in and rigging up	2.71	1.37
Dismantling	0.66	0.33
Drilling	12.27	5.88
Casing and cement	10.94	4.88
Completing and testing	5.58	1.10
Repairing	1.54	1.15
Other developments	1.25	0.50
Total time, days	34.95	15.21

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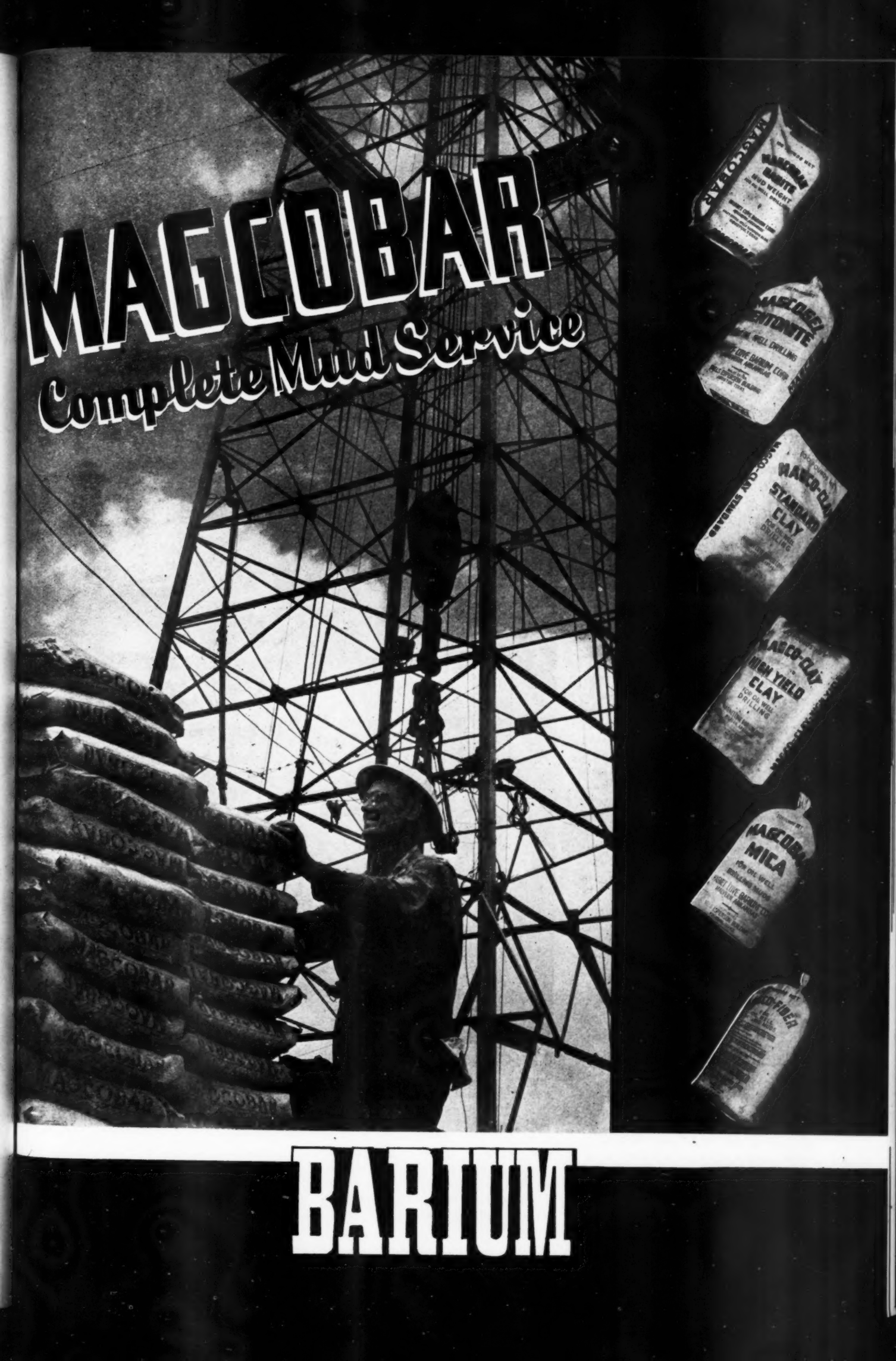
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Special Training for Venezuelan Workers

PETROLEUM ENGINEER Exclusive Feature

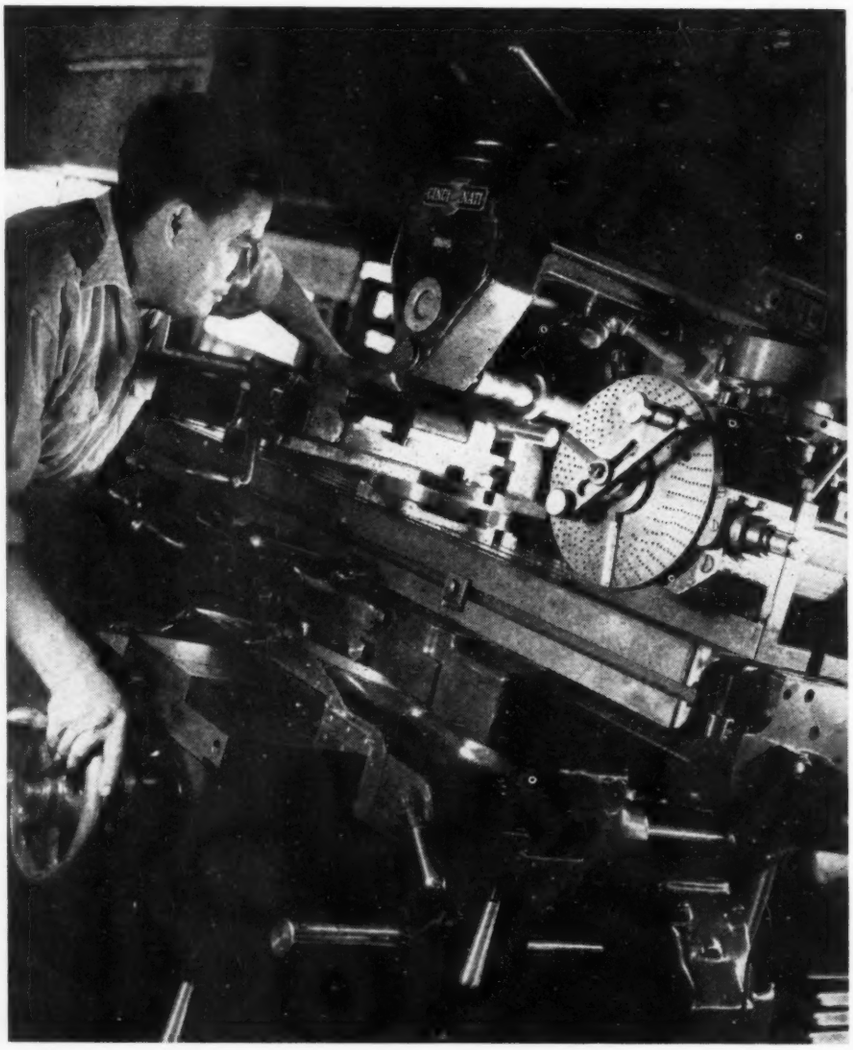
☆ Display marked aptitude for skilled jobs in oil industry

by Wallace A. Sawdon
Pacific Coast and Foreign Editor

TRAINING Venezuelan workers in specialized work within the petroleum industry began in camps of the Creole Petroleum Corporation from the beginning of oil operations in Venezuela. The result of this training in industry is reflected today in the various departments of the enterprise where numerous Venezuelans carry on, with undoubted efficiency, the duties of drillers, acetylene and arc welders, gasoline and Diesel motor mechanics, lathe operators, electricians, plant operators, boilermakers, etc. Venezuelan workers have shown a marked aptitude for adapting themselves to these skilled occupations.

About the middle of the year 1939 the marine department at the La Salina terminal began a short course for the purpose of qualifying the masters of tugs, launches, etc., so that they could obtain their license in accordance with the law. Some months later, 72 masters presented themselves for examination and only four failed in their efforts to obtain their licenses. After this auspicious beginning, the courses have continued up to the present, preparing sailors and machinists to take better jobs.

In 1939 a program of training in specialized work was also begun in the repair shops for floating equipment. Under the direct supervision of a foreign mechanic the apprentice workers were detailed in pairs to repair the Diesel motors that came into the shop. Actually the supervision has been reduced to a minimum and the Venezuelan mechanics are qualifying themselves to handle greater responsibilities.

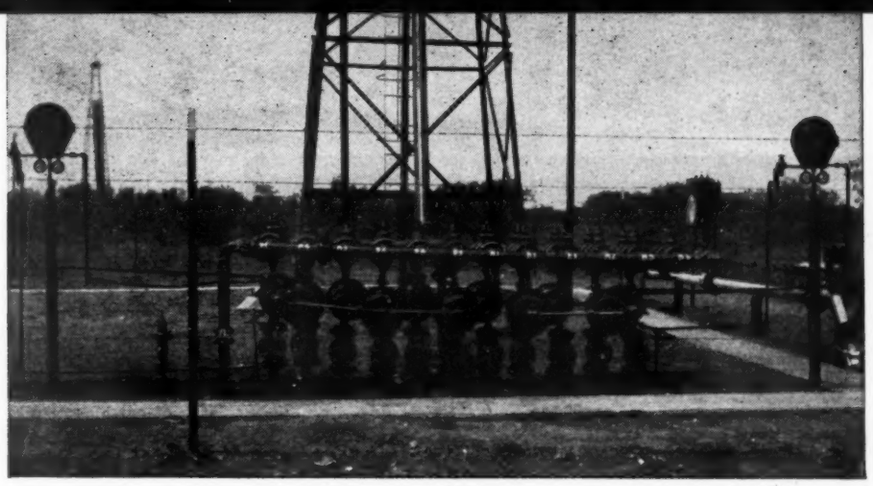


Venezuelan mechanic at the wheel—machine shop at La Salina, near Maracaibo

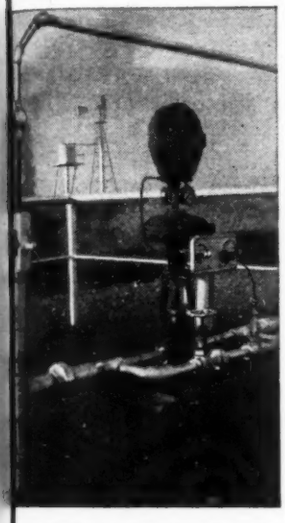
The training of mechanics, welders, and machinists continues to be given the greatest attention, even though the number of Venezuelans who have acquired sufficient knowledge and practical experience to act on their own initiative is already sufficiently great. The specialists, therefore, limit themselves to offering technical advice to the workers when it is asked for, or when in the case of very delicate work they feel that their intervention is necessary.

One of the earliest courses, begun in 1931, has been the application of first aid in accident cases. On initiating these courses only foremen, leading men, supervisors, and other employees in similar occupations were accepted. When they had acquired sufficient training the program was extended to the entire personnel.

From the outset these courses inspired marked interest among all classes of



Multiple well flowing using two H-W Type 980 Controls to actuate Motor Valves opening wells on common cycles



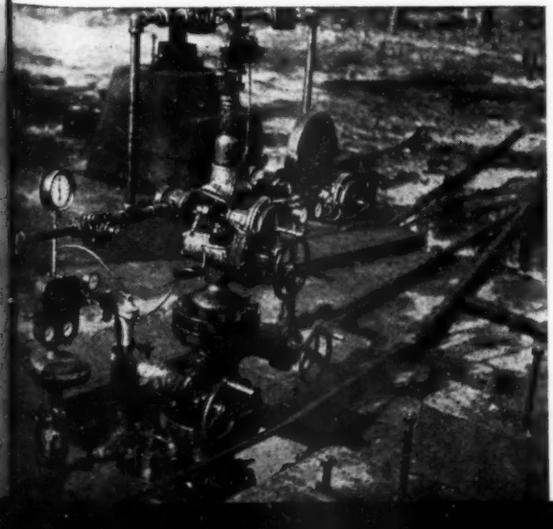
Intermittent gas injection to lift oil in double tubing string—prevents pressure on sand or formation. H-W Type 985 Controller with H-W Type 86 Motor Valves and H-W Type 303 Auxiliary Panel

Typical H-W TIME CYCLE CONTROL Installations

Showing various types of well flowing hook-ups utilizing H-W Type 980 and Type 985 Time Cycle Controllers with H-W Type 86 Motor Valves and H-W Auxiliary Equipment

Individual intermittent well flowing or "stop-cocking" (Automatic interval flowing) installation in North Texas Field

H-W Dual Motor Valve installation using H-W Type 980 Controller. One valve on input, other exhaust dual tubing string. Also H-W Type 775 Pressure Pilot with Type 86 Motor Valve and Auxiliary Equipment used as a Pressure Reducing Regulator



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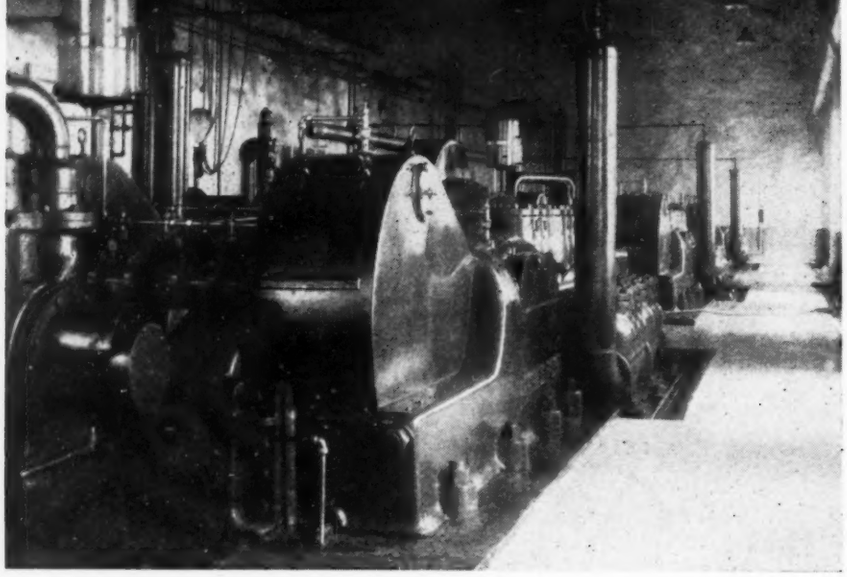

Skilled operators are required in pipe line stations such as this one in Eastern Venezuela

workers, particularly after their practical value had been demonstrated in actual instances where the knowledge acquired played an important part in saving human lives.

Here are two typical cases.

A little girl, daughter of a worker, accidentally fell into the lake. One of the foremen, a graduate of the course, happened to be present. When the child was pulled out of the water she was apparently lifeless. The foreman, however, without loss of time set himself to apply artificial respiration and after a considerable period of painful uncertainty the child revived.

The other incident also occurred on the lake, but this time at a considerable distance from shore. A worker accidently received a deep wound that bled profusely. This man's death would have been certain, in the opinion of doctors who attended him later, if it had not been for the application of preventive measures. A graduate of the safety course happened to be present and with all speed prepared and applied a tourniquet that saved the life of his companion.

In June of this year a commercial course was begun so that the office workers would also enjoy the benefits of the program of self-improvement. This course has been divided into two sections, accounting and secretarial. The first section covers studies in accounting, commercial arithmetic, and commercial correspondence; the second section offers training in typewriting, stenography, and Spanish.

On finishing the school year 1940-1941 three student graduates of the higher primary in one of the schools were employed by the Creole as apprentices in the department of petroleum engineering. These students were given a try-out in the different sections of the department before finally deciding on the section for which each was best adapted. The progress made by these students has been truly satisfactory and the success of this trial has encouraged the company to continue along the same line. Each year fresh graduates of the schools enter the different departments on a similar basis.

The entire program of self-improvement is carried on in the primary schools for workers that the company maintains scattered through all its departments. The need for this fundamental training has indicated the development of a more intense program of self-improvement in specialized industrial work.

☆ ☆ ☆

Venezuelan operating portable hoist on well repair

O·C·T SURFACE CONTROL EQUIPMENT SELECTED FOR TEXAS' FIRST TRIPLE COMPLETION

THE OIL WEEKLY • September 6, 1943

First Triple Completion in Texas At Lake Creek

By FRANK BRIGGS, Staff Writer

FIRST completion in Texas of a well producing simultaneously from three separate sands has been made by Superior Oil Company on its McWhorter lease at Lake Creek, Montgomery County. This field is in the Upper Gulf Coast (Wilcox trend) and [illegible] short [illegible] from the Common [illegible] wells have multiple sands. Because of the apparent economy, Texas conservation authorities have approved dual and triple completions in this area. Three sands can be produced at a cost of approximately one-third of that involved in completion of individual sands [illegible] high pressure and each is a separate and distinct reservoir with impervious formations between. The first of these sands is encountered around 9200 feet, just a little more than 700 feet below the top of the Wilcox formation. This [illegible]

OIL IS ESSENTIAL, TOO!—Although most of O-C-T's facilities are devoted to the production of vital war material, O-C-T has and will continue to find time to design and manufacture equipment essential to the production of oil.

Shop view of O-C-T 10,000 Lb. Test Christmas Tree which was designed for triple completions.

Cross-section view of O-C-T Well Head Assembly shown in the Christmas Tree photograph at right.

Whether for single, dual or triple zone completions, O-C-T Well Heads provide the surface control so essential to the success of these operations. For example, the O-C-T equipment illustrated in the above Christmas tree manifold, figured prominently in a recent triple zone completion in a deep Texas field. A Type "C-9" Casing Head was used to suspend and seal the long (7⅝") oil string set at approximately 12,000'. While this head provides an efficient resilient seal below the slips, an auxiliary seal was also effected above the slips with a Type "PF-1" Packoff Flange (see cross-section view). A similar casing head, the Type "C-9-D," was used to suspend and seal the intermediate (5") oil string set at approximately 10,000'. In addition to the standard resilient seal provided below the slips, this head was equipped with a stripper type packoff so that circulation could be established through the 5" casing for the purpose of washing the top sand into production and to permit movement of the pipe for setting a packer and operating circulation ports. A Type "PF-1" Packoff Flange was also installed above the Type "C-9-D" Casing Head to provide an auxiliary seal. A Type "T-16" Tubing Head with threaded type hanger to suspend and seal the tubing string, topped off the well head assembly. Lock down screws in the top flange of the tubing head are provided to hold the tubing hanger securely on its seal against expansion and to apply sealing compression to the resilient packing on the hanger.

The attention of operators who are interested in multi-zone well completions is directed to an editorial feature of The Oil Weekly for September 6, 1943, captioned: "First Triple Completion in Texas at Lake Creek."

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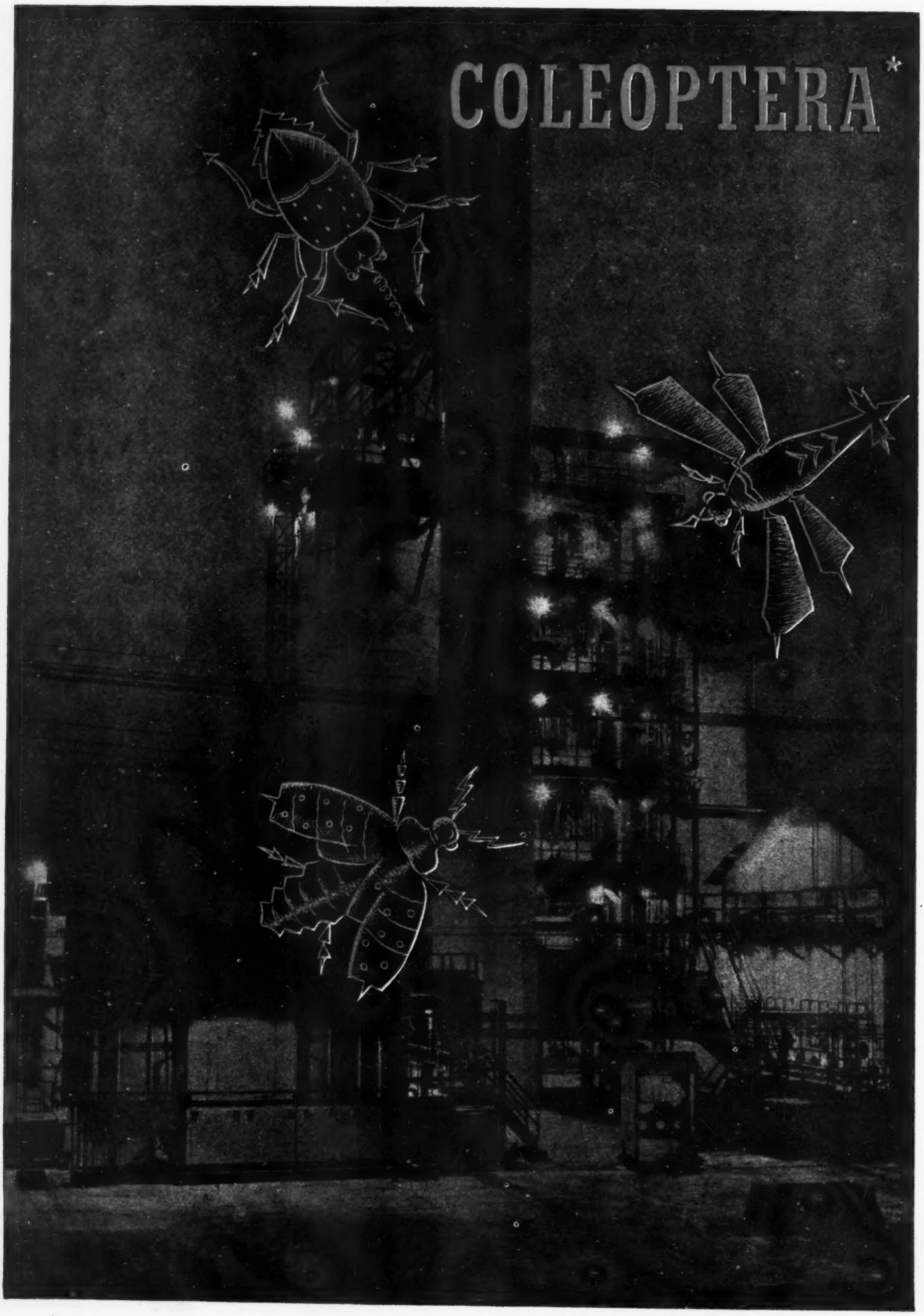
COLEOPTERA*

AND REFINING PLANTS

• Test tubes may establish the formula. Flow sheets may prescribe the process. Pilot plants may provide excellent samples. But it is when commercial production is undertaken that *"bugs" often appear.

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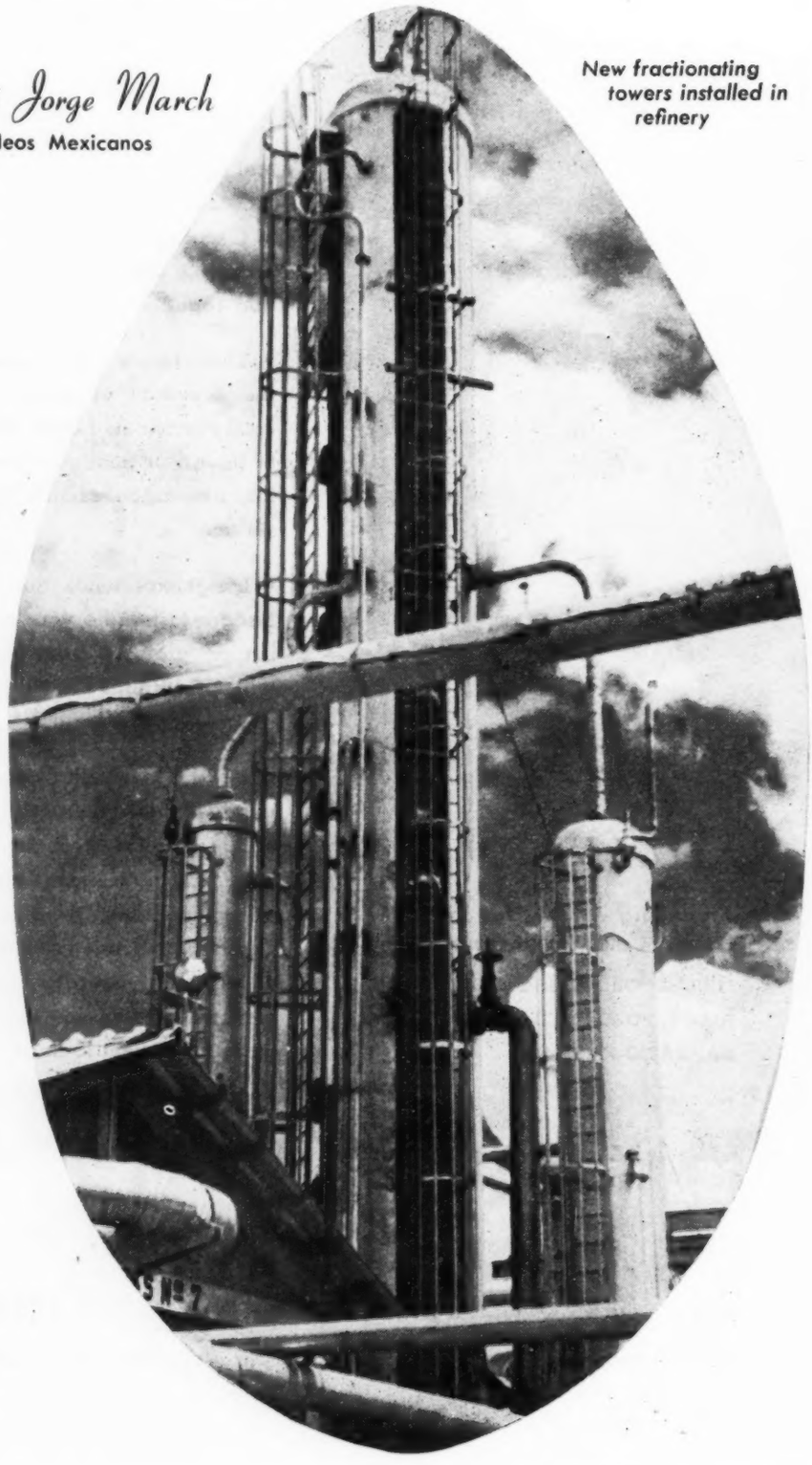
Current Status of Mexico's Petroleum Industry

☆ Summary of various phases of activity under government control

by José Jorge March
Petroleos Mexicanos



New fractionating towers installed in refinery

WHEN the Mexican petroleum industry was nationalized in March, 1938, the Mexican Government combined the various individual units, which had previously operated as competitive organizations, into one large operating corporation called Petróleos Mexicanos, known familiarly as "Pemex" from the trade name adopted for its products. Although owned by the Mexican Government, this organization operates, for all practical purposes, much the same as any private industrial corporation. With few exceptions all its personnel are Mexican, including its administrative executives as well as technicians.

The following summary, treating of the current status of this industry, is divided into sections dealing with its various spheres of activity.

Production

Since March, 1938, production of Mexican petroleum has followed closely the periodic fluctuations in sales volume. Annual production totals have also been characterized by irregular demand, in that export sales have been largely governed by changes in the world petroleum markets. For these reasons, the following production figures for the last several years, in barrels, should not be construed as indicative of the potential productive capacity of the Mexican petroleum industry:

Year	*Bbl.*
1938	38,467,000
1939	42,790,000
1940	41,876,000
1941	41,160,000
1942	32,955,000

As may be seen from these figures, production of Mexican petroleum increased from the beginning of 1938 until the middle of 1940, as foreign markets were found for a large part of the total production. From 1940 to the end of 1942, however, production declined with the cutting off of European and Asiatic markets as the result of war, and with the consequent curbing

THE TREND IS TO LOWER RIG MAINTENANCE

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Rig maintenance costs are steadily declining due to the fact that rig owners, in order to operate at a profit, have had to exercise more care in the selection and operation of drilling equipment. That most equipment manufacturers are striving constantly to improve the efficiency of their products has also helped lower the per foot cost of drilling. For example, until recently, mud line valves were a source of trouble and expense because they were designed for general service rather than for the specific conditions encountered in mud line service. The metal-to-metal seal in a conventional valve soon cuts out when exposed to the abrasive action of drilling fluid under high pressure. To eliminate this common item of drilling rig expense, Cameron engineers developed a valve expressly for mud line service . . . the Flex-Seal Valve . . . which employs a renewable resilient flow way insert to absorb the abrasive action of the drilling fluid and to provide a pressure-tight seat for the gate. All delicate sealing surfaces are eliminated. Renewable wear rings protect the detachable hubs against cutting. When the resilient flow way insert and wear rings eventually wear out, they may be replaced at the rig by the drilling crew for only a few dollars.

The design of the Cameron Flex-Seal Valve is so sound that it actually saved approximately 95% of the maintenance cost of conventional all-purpose valves and stop cocks. In drilling a single deep well on the Gulf Coast, an operator saves $870.00 in mud valve maintenance with Cameron Flex-Seals.

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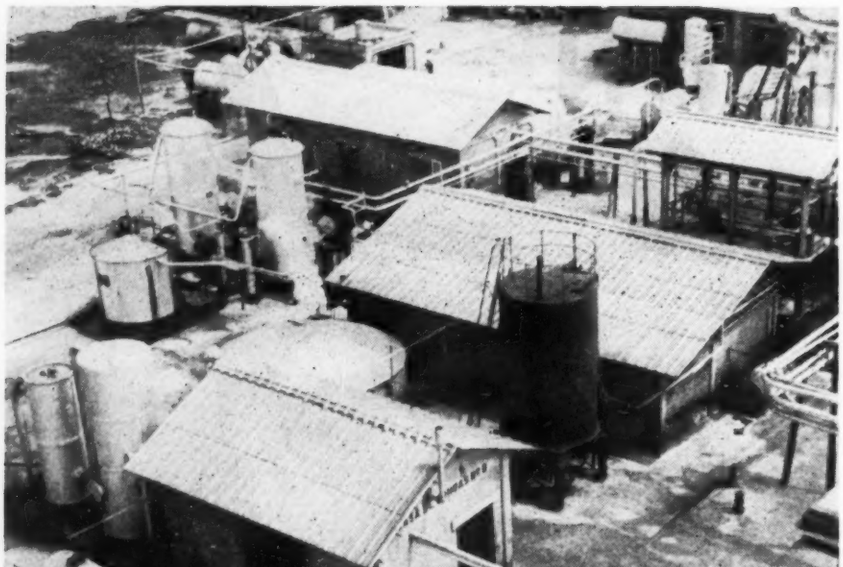

Much overhauling of refineries and installation of new equipment has been done within recent years

of export sales to the markets of the Americas, principally those of the United States.

It should be emphasized that this decline in production during the last three years does not signify any reduction in the productive capacity of Mexico's oil fields, as potential volumes have always been much greater than the volumes produced. Development work during the last five years, coupled with a comprehensive survey of Mexican petroleum reserves, has not only stepped up the production capacity but has also given the industry a solid footing upon which to establish itself. Careful estimates of known reserves indicate a conservative total of 750,000,000 bbl., a quantity equivalent to approximately 20 times the average annual volume produced since 1938.

Since the nationalization of the Mexican petroleum industry, its administrative policy has been guided by two fundamental considerations: (1) To conserve and protect with greatest care the known reserves, exploiting them only in accordance with the best technical practices, and (2) to devote every effort to the discovery of new fields, not only to offset the volumes already produced but also to augment the potential productive capacity of Mexico's petroleum.

To bring about a more efficient exploitation of known oil fields, Petróleos Mexicanos has made numerous technical studies of the units now in production. This is especially so in connection with Poza Rica, its most important field. In certain areas, investigations have pointed out the advisability of limiting the amount produced so as to conserve gas energy and prolong the life of the field. Other studies have resulted in important plans for improving production methods currently employed, with a view to obtaining the greatest possible returns from certain fields.

During the last five years, 91 wells have been drilled in various fields, of which 54 were producers. Plans for the current year include the drilling of 54 wells, as well as extensive new explorations not only of such known fields as Poza Rica, Pánuco, the Isthmus of Tehuantepec, and "Faja de Oro," but also in new areas such as to the west of "Faja de Oro," Chicontepec and south of Poza Rica, to the Sierra Madre Oriental mountain range, and in Tabasco; on the Pacific side, in Lower California, Sonora, and Sinaloa, and in the northeast of Mexico in the states of Nuevo León and Tamaulipas.

Plans have also been made for installing at Poza Rica the equipment necessary for making use of gas now wasted, reinjecting it into the wells after processing to increase the productive potentiality, at the same time obtaining products of great value and in urgent wartime need, such as solvents and high-octane gasoline.

Refining

One of the most difficult of the many problems that Petróleos Mexicanos had to meet after nationalization of the Mexican oil industry was the maintenance and improvement of its refineries. Immediate large-scale repairs and replacements were necessary. Many machine parts, as well as new equipment, which for various reasons could not be obtained abroad or in the United States, had to be made in Mexico. Partial repairs and replacements and even improvised equipment were made to serve temporarily until little by little the refining plants were put into satisfactory operating condition. In this connection it is only just to recognize here the enthusiasm and extraordinary cooperation of the Mexican technicians who satisfactorily solved this difficult problem in the face of formidable obstacles.

The most important of the major refinery improvements, effected during the last five years, may be summed up as follows: (1) Installation of new fractionating towers in the various refineries to increase the capacities of the primary distillation plants as well as to obtain a greater variety of derivative products; (2) construction of modern asphalt plants to replace the antiquated plant at Ciudad Madero; (3) reconstruction and adaptation of the old gasoline-treating plant at Ciudad Madero as a plant for the disintegration of heavy products; (4) completion of the primary auxiliary plant at Poza Rica, which was put into operation at the end of 1939; (5) installation of two heater units, each with a capacity of 10,000 bbl., to replace the 10 antiquated heaters at the Minatitlán refinery; (6) installation of three large boilers at the Minatitlán plant in substitution of those that had been functioning for more than 30 years, and (7) improvements and installation of new equipment at the Bellavista refinery, which resulted in a substantial increase in the output of this unit.

The various improvements, replacements, and additions of new equipment to the several refining units in Mexico have not only brought about a steadier operation as the result of better methods and a markedly increased mechanical efficiency, but have also succeeded in stepping up appreciably the productive capacity of the refineries.

Petróleos Mexicanos has formulated a comprehensive program for the modernization and expansion of its various refining units. The work is being accomplished as rapidly as possible, and when completed it will place the Mexican petroleum industry, from the standpoint of production, on a par with the most efficient producing organizations in other countries. Special attention is being given to flexibility in production so that the plants may readily adapt themselves to changes in market demand, including sufficient reserve capacity to meet emergency needs. Plans also include the installation of considerable new equipment to obtain by-products that cannot be produced under the existing plant facilities, or can be produced only on a limited scale. The production of liquefied gas will also be

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increased, and at less cost to the consumer, to take care of the growing demand in Mexico for this fuel, especially in Mexico City where it is rapidly gaining in popularity for industrial use as well as tending to replace charcoal for domestic needs.

Transportation

In methods and equipment for distribution, which include transportation by pipe line, railroads, tank wagons, and tank ships for the movement of the bulk of petroleum products within Mexico as well as to foreign markets, the industry has made considerable progress during the last five years.

Pipe lines in existence at the time the Mexican petroleum industry was nationalized had neither the flexibility nor capacity to move the volume of petroleum demanded by the increasing domestic market of Mexico, nor did they offer adequate facilities for moving the volume destined for export. The principal improvements in this connection, which have been made since 1938, consisted of increasing the capacity of the pipe line from the Poza Rica field to the refinery at Atzcapotzalco, on the outskirts of Mexico City, from 15,000 bbl. to 22,500 bbl. daily; and of augmenting from 40,000 to 63,000 bbl. the daily pipe line capacity from Poza Rica to Tampico. Due to the mounting demands on the Atzcapotzalco refinery, situated as it is at the edge of the ever-growing capital of the republic, plans have been made for further increasing the capacity of the Poza Rica-Atzcapotzalco pipe line to 30,000 bbl. daily.

Probably the most acute transportation problem facing the Mexican petroleum industry at the time of its nationalization was the serious shortage of railroad tank cars for the movement of its products to certain markets. In 1938, the total on hand was only 777 cars. The acquisition of 639 additional tank cars since that time gives a current total of 1416. Automotive equipment has also been materially increased. To the 458 motor vehicles on hand in 1938, comprising tank wagons, stake trucks, and passenger cars (some of which have since been disposed of, having outlived their usefulness), Petróleos Mexicanos has added by purchase 220 new units, and at the present time operates some 530 vehicles.

In 1938 Petróleos Mexicanos had only one tankship suitable for offshore service in addition to several small craft used to distribute petroleum to seaports and river ports within Mexico. Combined tonnage of these ships was only 17,500. Since then several additional tankers have been acquired, five of which were sunk last year by Axis submarines. Despite this formidable loss, Petróleos Mexicanos now has in service 84,000 tons, principally tankers and including ships owned directly by the industry and its subsidiaries, as well as additional ships totaling 53,250 tons owned by the federal government but operated by the petroleum administration for the exclusive use of the industry. Some time ago Petróleos Mexicanos purchased three tankers in Europe, but these have never been delivered because of war. Additional tankers will be purchased when war conditions permit.

Bulk Plants and Terminals

Many important changes have been made to the network of bulk distributing plants throughout Mexico. Prior to 1938, when competitive petroleum organizations were operating in Mexico, each such company established its own bulk plants in the strategic distribution centers of the Republic. Since 1938, however, Petróleos Mexicanos has been engaged in centralizing these plants, by the elimination or combining of excess units in the interests of efficiency. The work has been done gradually after careful study of specific regional or community needs. New bulk plants have been built in centers that previously lacked the necessary distributing facilities.

In 1938, the total storage capacity of these bulk plants was 223,150,000

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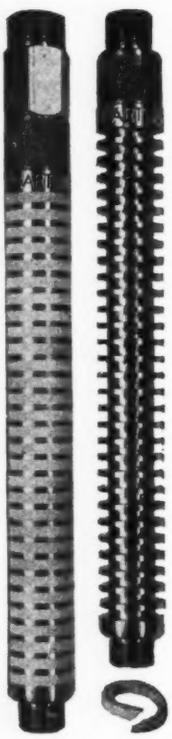

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liters (58,952,000 gal.). This total has since been increased to 274,400,000 liters (72,493,000 gal.). To date, bulk plants have been centralized in 25 points in Mexico, out of a total of 47 distributing centers marked for centralization.

Of primary importance is the large new distributing terminal recently erected by Petróleos Mexicanos at the port of Salina Cruz to supply the needs of West Coast Mexico. This plant, at the Pacific end of the narrow Isthmus of Tehuantepec, is supplied by tank car shuttle service across the Isthmus from the refinery at Minatitlán, close to the Gulf Coast. Tankers, loading at the Salina Cruz terminal, quickly and economically distribute to all major ports on the West Coast of Mexico, thus eliminating the slow and costly distribution previously accomplished by tank cars making long trips from the producing centers, all on the Gulf Coast side. A glance at a map of Mexico will clearly show the reason for this new terminal.

Plans have been made for the construction of a tidewater storage terminal at Campeche, so as to supply the Yucatán Peninsula region more efficiently, and at Acapulco and Punta Prieta, both on the West Coast side. The last two plants will be supplied by tankers from Salina Cruz.

Sales

The total annual volume of domestic sales of Mexican petroleum products have shown a continuously upward swing since the nationalization of the industry in March, 1938. For the previous year of 1937, total sales within Mexico amounted to 156,000,000 pesos.

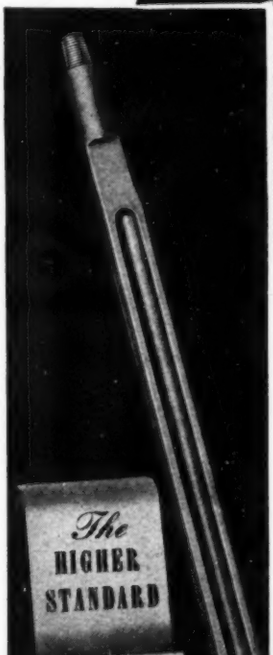
Following are the totals since that time, exclusive of export sales:

Year	*Mexican pesos*
1938 (9 months)	155,000,000
1939	170,000,000
1940	191,000,000
1941	222,000,000
1942	254,000,000

These totals of domestic sales for the last five years are comparable on a uniform price basis, for it is important to note that notwithstanding materially increased production costs, Petróleos Mexicanos has been able to maintain up to the present time, with very few and unimportant exceptions, identically the same unit prices on domestic sales of their various products as were in effect prior to the nationalization of the industry—a fact, be it added, in which the Mexican petroleum industry takes justifiable pride.

Export sales of Mexican petroleum for the last five years show a considerable variation, due to international conditions beyond the control of the indus-

Bring the **GREAT DAY** *Closer!*



Buy Wisely... Use Carefully

Now, more than ever, start with the finest equipment you can get . . . conserve it carefully to lengthen its lifetime of service . . . that's one of your wartime duties.

Spang "Higher Standard" Cable Tools are BUILT TO ENDURE. You can depend on them for lasting efficiency.

SPANG & CO., Butler, Pa.

SPANG

THE BIGGEST NAME IN

CABLE TOOLS

Consumption and manufacture of liquefied petroleum gas have shown a marked increase in Mexico

try. Totals for this period are as follows:

Year	*U. S. dollars*
1938	8,984,000
1939	14,655,000
1940	16,000,000
1941	15,300,000
1942	7,378,000

Export sales for 1943, to date, show a large gain over the reduced sales of the previous year. Since 1941, export sales have been for cash rather than on a basis of barter and trade, as was previously the case. Prices per unit for the various products have also increased, as may be seen from the following table of average prices realized for Mexican petroleum exports, per barrel, during the last five years:

Year	*U. S. dollars*
1938	0.98
1939	0.87
1940	0.89
1941	0.96
1942	1.10

Finances

After nationalization of the Mexican petroleum industry, the organization charged with its management did not receive sufficient operating capital for the proper administration of so large an industrial enterprise. Nevertheless, with the help of the federal government—specifically that of granting extensions of time for the payment of some of the industry's taxes as well as making a few direct loans to Petróleos Mexicanos, which were later paid off—the industry has been able to make substantial progress, even increasing its investment by 145,000,000 pesos. Of this new investment total, 60,000,000 pesos was supplied by the federal government and the rest by the industry itself.

Petróleos Mexicanos is up to date in all its financial obligations, including the punctual payments of all taxes to the federal and various state and local governments. In 1942, federal taxes alone totalled 80,000,000 pesos, which was the greatest amount paid in the history of the Mexican oil industry and some 27,000,000 pesos in excess of the largest annual total ever paid by all the individual companies operating in Mexico prior to 1938. To defray ordinary operating expenses, Petróleos Mexicanos keeps on hand a cash balance of approximately 38,000,000 pesos. As may be inferred from these figures, the industry has established itself on a very sound financial basis.

Labor Conditions

Petróleos Mexicanos has increased the salaries and wages of all its personnel to a point where they now enjoy the highest remuneration of any labor group in Mexico. Many classes of employee benefits have also been established, especially in the field of health and social benefits. Although these benefits and wage standards represent large increased costs to the Mexican petroleum industry, action was taken in accordance with the administration's fixed policy of raising the standard of living of the Mexican petroleum worker to the highest degree that the industry can afford, thus procuring, reciprocally, the entire cooperation and loyalty of its personnel. The only limits that have been imposed on the reasonable demands of the workers is that, above everything else, the financial equilibrium and security of the industry itself be maintained and protected at all times.

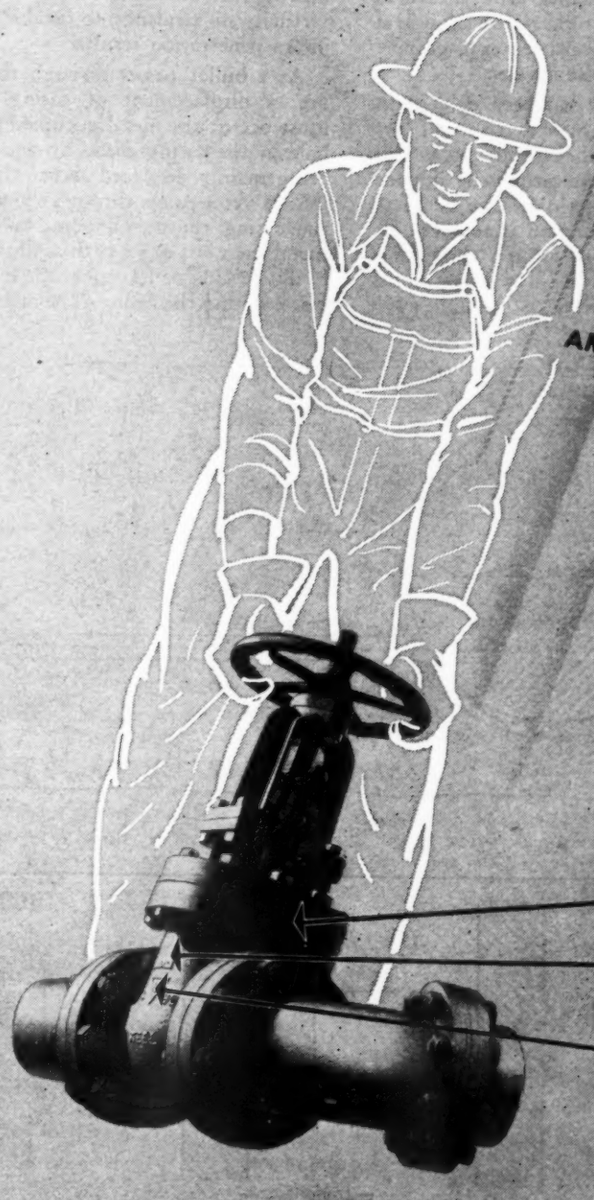
It is gratifying to report the wholehearted response of the Mexican petroleum worker to the benefits he has received. Although there have been minor disputes between the administration and petroleum labor during the last five years, these have in all cases been settled amicably and to the satisfaction of both sides. Particularly satisfying to the administration is the increased sense of responsibility in the individual as well as collective attitude of Mexican petroleum labor toward its job, which has come about as the direct result of fair treatment coupled with social benefits and a better wage standard.

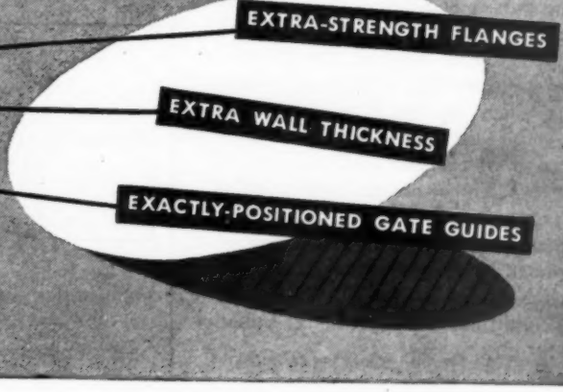
—— ☆ ☆ ☆ ——

Decentralized bulk plants aid domestic distribution

BETTER OIL COUNTRY VALVES COME OUT OF THE WAR

The valves you held have gone through over two years of relentless pressure on all angles of their production. . . . The valves made have gone to war. They continue to take the most direct route to war. So far, none have become available for routine use. . . . But, mark this down: the demands made upon us by this war of which no sane man wants a part have brought to us a wealth of added "know how and better" —things fried out in the heat of intense production—on specific points of the very valves we will be producing for you as soon as there is relief from the pressure upon us. Better Oil Country Valves have come out of the war.





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A DIVISION OF
AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT, CONNECTICUT

New Bullet Design For Gun Perforating

☆ Ogival point aids performance with respect to flight, penetration, and metal displacement

PETROLEUM ENGINEER Exclusive Feature

by

Wallace A. Sawdon

Pacific Coast and Foreign Editor

A CRITICAL relationship exists between the weight of a bullet and the size and design of the gun from which it is fired. Within certain limits there can be variations in the weight and shape of the bullet; and bullet design aims at maximum effectiveness within these limits. To obtain greater effectiveness a new type of bullet for gun perforating has been made with an ogival point[1] and tests and field practice have indicated improved flight, penetration, and metal displacement.

The outline shape of the ogival point is a pointed arch, as disclosed by the accompanying drawings. This produces a thicker extreme point of greatly increased strength. The center of gravity is forward from that of the conical pointed bullet and this is asserted to help keep the bullet traveling in a straighter path when it strikes the casing at a slight angle. This angle condition may occur when the gun, freely suspended in the well, takes an eccentric position in the casing as shown in Fig. 1. The greater the difference between the diameter of the gun and the inside diameter of the casing the more pronounced is the eccentricity.

In Fig. 1 a gun of small diameter is being used in casing of comparatively large diameter. If the outside diameter of the gun is one-half the inside diameter of the casing as here shown, the maximum angle between the bullet's line of flight and the wall of the casing occurs when the barrel is pointed at right angles to a line drawn through the center of the gun and its point of tangency with the casing. Bullets striking at any other point penetrate at a less acute angle, and as the relative size of the gun increases, the most acute angle approaches the normal. Under acute angle conditions the point of the bullet is subjected to rather severe lateral stresses and the strong tip of the ogival shape and the forward center of gravity aid in resisting those stresses.

Flight stability has been evident in tests made through three strings of casing where the bullet's course was still straight after penetrating the outside casing. In single strings, deep penetration into the formation is achieved by the bullet passing through the casing without deviation even when striking the casing angularly. As the bullet enters the formation point foremost, with virtually no tendency to tumble, maximum penetration results.

As a bullet passes through the casing, a displacement of casing metal must occur, the metal occupied by the hole in the casing made by the bullet being mainly displaced rather than removed. As it passes through the wall of the casing the ogival point rolls this metal back out of its path as illustrated by Fig. 2. In the left view the bullet is just entering the casing. The metal that

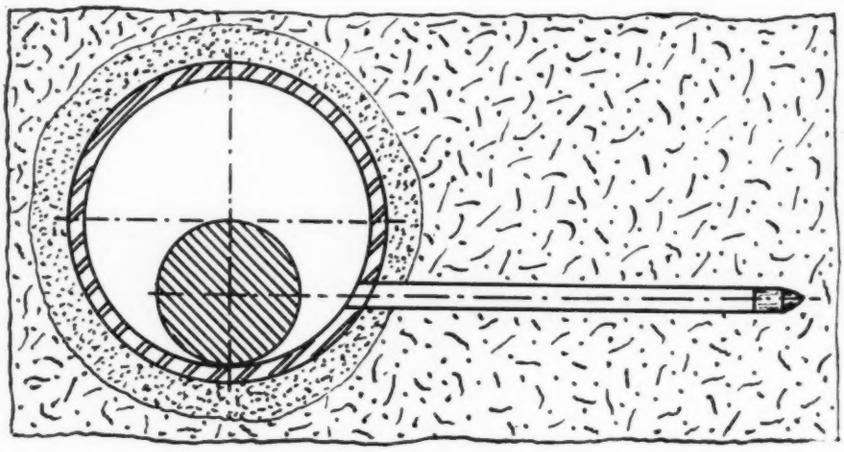


Fig. 1

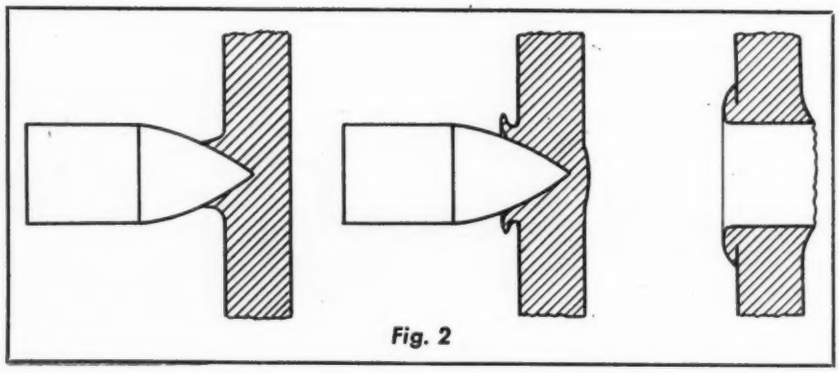


Fig. 2

[1]The Lane Wells "Steelflo" ogival point gun perforating bullet.

To keep control costs DOWN

KEEP UP WITH McALEAR

Precision Controls for Regulating...

PRESSURE

FLOW and LIQUID LEVEL

TEMPERATURE

HOW TO USE McALEAR SERVICE

Look to McAlear for leadership and pioneering in the field of pressure valves and fluid transport controls. For precision engineered control devices that reduce down-time . . . and hold maintenance expense to an absolute minimum.

McAlear has never shied away from specification jobs requiring research and development. Nor do we even today. We continue to seek opportunities to design and develop special controls for specific applications.

If you have a control problem call on McAlear engineers. Draw on their fund of experience, on their ability and readiness to help you, whether for wartime application or post war planning. For informative bulletins and catalog, write McAlear Manufacturing Company, 1909 S. Western Ave., Chicago.

McALEAR

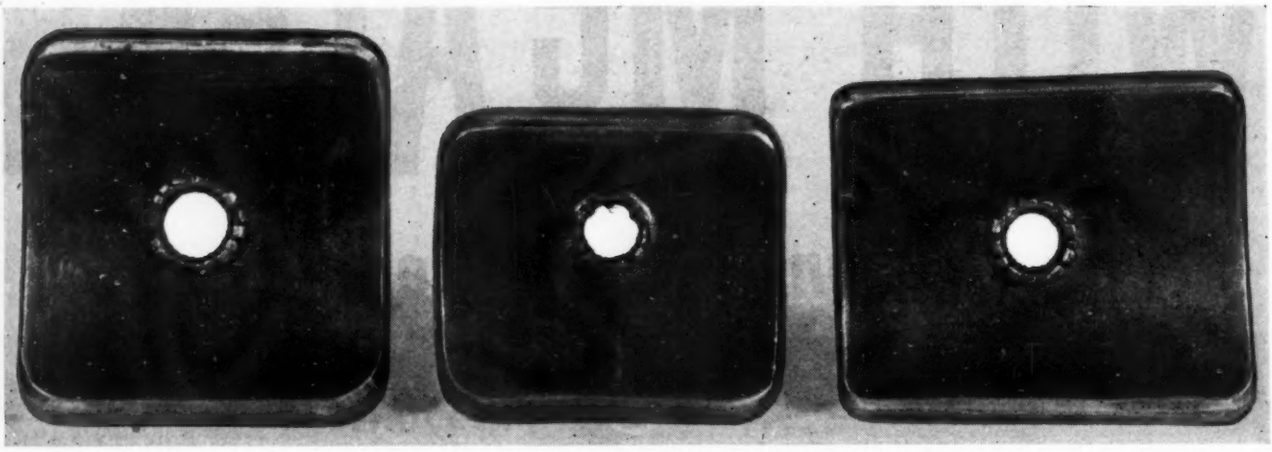
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE

controls

for STEAM. WATER. AIR. OIL AND GAS

Right—Size and shape of ogival point bullets shown in comparison with cone-point bullets

Below—When pierced by ogival point bullet metal is displaced in this manner



forms the burr takes the path of least resistance and begins extending along the bullet point. As the bullet penetrates the casing deeper as shown in the central view the burr begins to fold due to the curvature of the point. In the right view, the bullet has passed through the casing, leaving a tightly folded burr with its edges rolled against the inside wall without sharp projections. Of the many tests conducted throughout the development work on the ogival bullet, the smoothly rolled bead was characteristic and the performance was constant in all grades of casing. Consistency was also apparent throughout the tests in respect to the features of straight flight, point strength, and deep penetration.

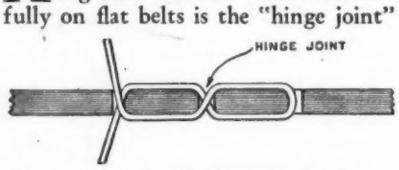
The ogival shape permits a shorter bullet for the same weight. When the perforating gun is lowered to the shooting depth on a freely suspended cable it will, in the majority of cases, come to rest against one side of the casing. Nearly every well has a slight inclination from the vertical and the gun will, therefore, rest on the lower side. As the gun barrels are axially spaced in the body, some of the muzzles are likely to be pointed very near to, or directly at, the point where the gun is closest to the casing wall. It is thus possible for the casing to be directly against the muzzle of the barrel and the bullet in such a case will strike the casing while still within the barrel.

Gun perforator barrels are necessarily short because they are limited by the inside diameter of the casing and the barrel length (except in the larger guns) is seldom more than three times the bullet length, frequently not over twice the length. If the bullet encounters the casing when its base has traveled only one-half to two-thirds the length of the barrel, the power gases do not have an opportunity to develop full velocity nor impart full energy to the bullet. From literature on interior ballistics it is known that energy imparted to a bullet is a function of the force propelling the bullet multiplied by the distance through which the force acts. The ogival design permits a shorter bullet without reducing its weight and thus provides a greater distance of travel from a fixed base. This results in a longer effective barrel and consequent greater velocity and penetration.

—— ☆ ☆ ☆ ——

How To Make A Hinge Belt Joint

AN EXCELLENT type of belt lacing that has been used successfully on flat belts is the "hinge joint"



shown in longitudinal section in the accompanying sketch.

The principal feature of this joint is its flexibility, as it is more pliable than the ordinary rawhide-laced joint. When the joint is bent there is no "tension side," hence virtually no resistance. It is therefore unsurpassed for use on small pulleys. Note that the lace is always passed between the ends of the belt instead of running straight from hole to hole as in other styles of lacing. The method of punching and lacing is otherwise about the same as with other methods. Staggered punching is preferred.

—— ☆ ☆ ☆ ——

The Texas Company's policy of many years' standing is to make its patents and inventions available to the petroleum industry at prices that are reasonable.

•

Address:

TEXACO DEVELOPMENT CORPORATION

A subsidiary of The Texas Company

26 Journal Square · Jersey City, N. J.

Tube Borium Keeps 'em digging

DULL IN 3 DAYS
STILL SHARP AFTER 30 DAYS
STOODY TUBE BORIUM* KEEPS DITCHER TEETH SHARP ...ELIMINATES FREQUENT SHUT-DOWNS FOR TOOTH CHANGES...CUTS REPLACE-MENT COSTS UP TO 75%

The two ditcher teeth pictured above were used on the same machine and operated under identical conditions.
The unprotected tooth at the top had to be sharpened every three days and was too short for further service after six sharpenings.
But the Borium-protected tooth at the bottom operated for 40 days and wore only ½". It was simply resharpened in the forge, retipped with Tube Borium, and put back on the ditcher for another 40 days' service.
Before the tooth was finally worn out, it had operated a total of 120 days!
Tube Borium makes such savings possible because the deposits represent the ultimate in wear resistance and the ability to cut hard earth formations.

*Stoody Tube Borium is supplied in rods of ⅛", 5/32", ¼" and ⅜" diameters and is available for either oxyacetylene or D.C. electric application. Prices and specifications are yours for the asking.

These tungsten carbide particles do not melt when tube is applied but are held in suspension in a mild steel matrix forming a deposit resembling coarse sandpaper.

Send for free booklet on TUBE BORIUM, showing sizes and styles of rods and recommended methods of application.

STOODY COMPANY
1142 West Slauson Ave., Whittier, Calif.

STOODY HARD-FACING ALLOYS
Stop wear... Eliminate Repair

LAUGH WITH BARNEY

Mess Sergeant: You're not eating your fish. What's wrong with it?

Private: Long time no sea.

* * *

An overseas Sergeant wrote to a friend: "It has been so long since I've heard from you that you are practically a stranger."

The letter was returned with the censor's notation: "Military personnel are not permitted to correspond with strangers."

* * *

She was only a grave-digger's daughter but you ought to see her lower the beer.

* * *

Two old maids were discussing men. Asked one: "Which would you desire most in a husband—brains, wealth, or appearance?"

"Appearance," replied the other, "and the sooner, the better."

* * *

Those Little Morons Are Here Again

Then there were the two little morons who were each given a horse.

"How are we going to tell them apart?" asked one.

"I'll cut off my horse's mane," suggested the second. So they trimmed one horse's mane but it soon grew out again. The first little moron then cropped his horse's tail but it, too, soon grew out.

"Let's measure the horses," suggested the first little moron. Sure enough, it worked. The white horse was two inches taller than the black horse.

* * *

A certain newspaper editor had cause to admonish his son on account of his reluctance to attend school.

"You must go regularly and learn to be a great scholar," said the fond father encouragingly, "otherwise you can never be an editor, you know. What would you do, for instance, if your paper came out full of mistakes?"

"Father," was the reply, "I'd blame 'em on the printer."

And then the father fell on his son's neck and wept for joy. He knew he had a worthy successor for the editorial chair.

* * *

"The new nurse is very scientific. She never lets anyone kiss the baby when she is around."

"Who would want to?"

* * *

Of all the fishes in the seas,
My favorite is the bass,
He climbs up into the sea-weed trees,
And slides down on his hands and knees.

Mrs.: "How do you suppose those dozens and dozens of empty bottles got into the cellar?"

Mr.: "I'm sure I don't know, I never bought an empty bottle in my life."

* * *

"It sure looks that way."

"Looks like what?"

"Like clothes rationing has arrived, because girls must have two points before they can buy a sweater."

* * *

"Can you loan me ten for a month, old boy?"

"Don't be silly, what could a month old boy do with ten dollars?"

* * *

A visitor at a golf club paid his greens fee and fixed up a match. At the first tee he made a wild swing and completely missed the ball.

"By Jove," he said, "It's a good thing I found out right at the start. This course is at least two inches lower than the one I usually play on."

* * *

Pure Scotch

Gregory, a seafaring man, was medium-sized and not very imposing. One night ashore he walked into a small honky-tonk bar, and with a flourish and a voice that filled the room said: "When Gregory drinks, everybody drinks."

Immediately the bar was jammed, the house filled all the glasses and everybody drank. Then, with the impertinence of a king, Gregory reached into his pocket, pulled out a coin, laid it on the counter and said: "And when Gregory pays, everybody pays." And out he walked.

* * *

"I like him less and less."

"Why?"

"He's the type that when he pours a drink and you tell him to stop, he stops."

* * *

The track supervisor received the following note from one of his foremen:

"I'm sending in the accident report on Casey's foot, which he struck with the spike maul. Now, under 'Remarks,' do you want mine or Casey's?"

* * *

Girls, when they went out to swim
Once dressed like Mother Hubbard;
Now they have a bolder whim,
They dress more like her cupboard.

* * *

Agent: Sir, I have something here which will make you popular, make your life happier, and bring you a host of new friends.

Prospective Customer: I'll take a quart.

BAKER OIL TOOLS, INC.
Main Office and Factory:
6000 So. Boyle Ave., Box 127, Vernon Station, Los Angeles, Calif.
Central Division Office and Factory:
6023 Navigation Blvd., Box 3048, Houston, Texas
Export Sales Office:
19 Rector Street, New York, N. Y.

General Heading: BAKER MODEL "K" CEMENT RETAINER

Unit No. A-19

Subject: Squeeze Cementing Shut Off Wet Zone

Index: 250.1
Date: October, 1943
Page: 1 of 1 p.

Squeeze cementing affords a safe, economical solution to many present-day well repair and well completion problems. Thousands of such jobs have been successfully performed with the Baker Model "K" Cement Retainer, which has long been a standard unit of equipment for accomplishing difficult as well as the usual run of squeeze cementing jobs.

Two such typical applications are described and illustrated below.

Today, with conservation of time and materials being of the utmost importance, it is essential that successful results be secured the first time . . . and the Baker Model "K" Cement Retainer has a reputation for obtaining a successful "first-time" job.

If you are not familiar with this device, you can secure complete details from any Baker office or field representative, or see pages 250-263 of the 1942 Baker or Composite Catalog.

Service Note

Competent Baker men will service, make suggestions, and otherwise assist in securing best possible results.

Prod. No. 400

Baker Model "K" Cement Retainer

BAKER MODEL "K" CEMENT RETAINER APPLICATIONS

Recementing • Cementing Behind Sections of Pipe
Reducing Gas/Oil Ratios • Plugging Off Bottom Fluids
Plugging Back to Upper Zones
Testing Upper Cased Formation • Squeeze Jobs
Cementing Off to Perforate for Production
Cementing Bad Pipe • Cementing Two Strings Together
Cementing Low-Pressure Zones
Use of Cementing Retainer as Casing Bridge Plug

JOB NO. 1

PROBLEM:

To shut off water entering from bottom of producing zone.

METHOD:

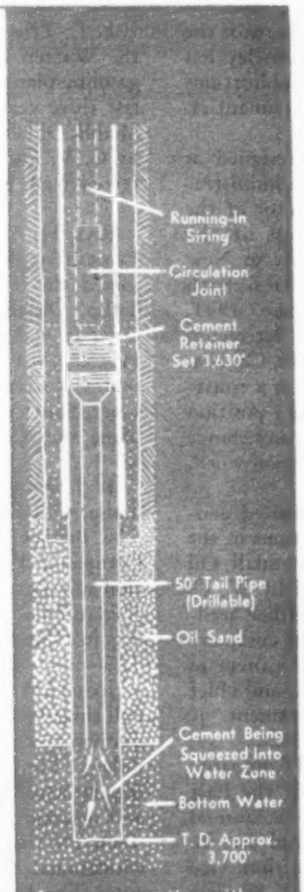
Squeeze cement with Baker Cement Retainer equipped with 50′ drillable) Tail Pipe.

RESULT:

Water completely shut off (before performing squeeze, production was cutting 35% water).

DETAILS:

Field: Kilgore, Texas
Depth of Well: 3700′
Depth Retainer Set: 3630′
Breakdown Pressure: 500 pounds
Final Pressure: 2100 pounds
Number of Sax Put Away: 534
How Cement Discharged: Through lower end of Tail Pipe into open hole.



Squeeze cementing with Baker Cement Retainer (with Tail Pipe) to shut off bottom water.

JOB NO. 2

PROBLEM:

To squeeze off lower wet sand and protect upper oil zone.

METHOD:

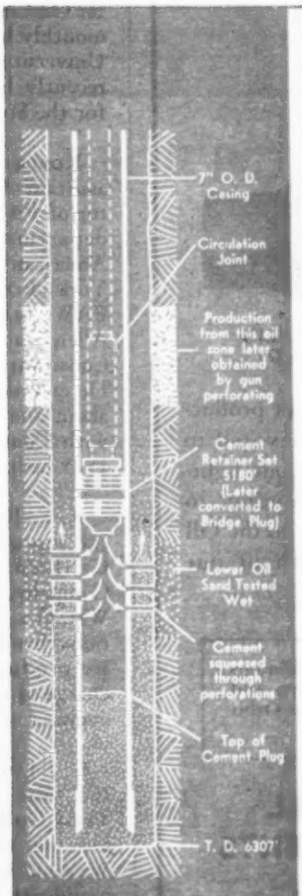
Perform squeeze cement job with Baker Cement retainer and then convert Retainer to Casing Bridge Plug.

RESULT:

Wet zone completely shut off; upper zone produced with no water.

DETAILS:

Field: Golden Meadows, La.
Depth of Well: 6307′
Depth Retainer Set: 5180′
Breakdown pressure: 1400 pounds
Final Pressure: 2500 pounds
Quantity of Cement Mixed: 300 Sax
Number of Sax Put Away: 300
How Cement Discharged: Through Perforations


7" O. D. Casing
Circulation Joint
Production from this oil zone later obtained by gun perforating
Cement Retainer Set 5180′ (Later converted to Bridge Plug)
Lower Oil Sand Tested Wet
Cement squeezed through perforations
Top of Cement Plug
T. D. 6307′

Squeezing Off Lower Wet Zone with Baker Cement Retainer

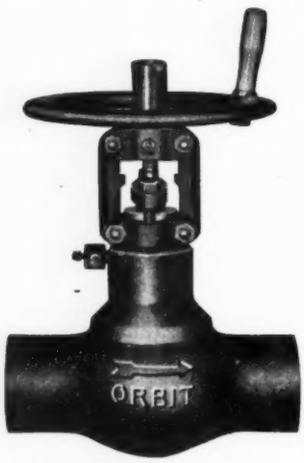
OIL WELL IMPROVEMENTS CO.

Pioneer creator and manufacturer of drilling and producing equipment, has been in the

FIRST LINE
of the Oil Industry's
Production Front

Now . . .

OWI products are serving in the
FIRST LINE
of the Navy's
Destruction Front



ORBIT WING VALVE (SCREWED END)

And while most of our production facilities are devoted to vital production for our fighting Navy, we will continue to furnish Orbit Valves to the Oil Industry to the limit of our ability.

If you have any questions regarding the care and maintenance of your Orbit Valves, write us.

OIL WELL IMPROVEMENTS CO.
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Running Tour

WITH MEN IN THE INDUSTRY

MARK S. PATTON, Tulsa, Oklahoma, is the new director of natural gas and natural gasoline for the Petroleum Administrator for War in the midwestern states, District 2. He is on leave of absence from Hurley Gasoline Company of which he is the owner. Patton was assistant to SETH W. HERNDON on PAW, who resigned to return to the Herndon Drilling Company of Tulsa.

CHARLES H. PISHNY, petroleum engineer with Amerada Petroleum Corporation for 15 years, has resigned to become a partner in the consulting firm of Cummins and Berger, Fort Worth, Texas. No successor has been named to Pishny, according to ALLMAND M. BLOW, vice president of Amerada.

HARRY KNISELEY, JR., has joined the public relations department of the Carter Oil Company as editor of *The Link*, monthly house organ. A graduate of the University of Oklahoma, Kniseley has recently been director of publications for the Spartan School of Aeronautics.

ROBERT E. ALLEN has resigned as assistant deputy petroleum administrator of PAW to become director of the department of information of the American Petroleum Institute in New York. Prior to his connection with PAW, which began in June, 1941, Allen was chairman of the Petroleum Conservation Board of Alberta, Canada. He entered the oil industry as a roustabout and rose to a supervisory position with Continental Oil Company. Since 1929 he has been in conservation work.

R. E. Ross has been appointed general superintendent of operations in the California division of Barnsdall Oil Company, it was announced by W. C. WHALEY, vice president. Other positions that Ross has held in the company are production foreman, engineer in charge of construction work, and chief engineer of the drilling department.

G. J. LOETTERLE, Shell Oil Company, Inc., was chosen president of the East Texas Geological Society at the annual meeting. Other officers elected are: B. W. ALLEN, Gulf Oil Corporation, vice president; LYNN L. HARDEN, Sinclair Prairie Oil Company, secretary-treasurer, and J. H. MCQUIRT, member of the executive committee.

WILLIAM R. ARGYLE has been appointed assistant director of the refining division of Petroleum Administration for War. Argyle is on leave of absence as assistant manager of refining of the Sinclair Refining Company, with headquarters at Marcus Hook, Pennsylvania. He has been with Sinclair since 1920 and prior to that was on the staff of the U. S. Bureau of Mines.

KENNETH E. COOK, of the public relations department of the Standard Oil Company of New Jersey, 30 Rockefeller Plaza, New York City, has been granted a leave of absence to join the public relations department of the Petroleum Administrator for War, in Washington, D. C. Cook will be engaged on a special assignment, which is expected to be completed within three months.

F. E. THOMPSON, superintendent of the Warren Petroleum Corporation's gasoline plant at Salem, Illinois, for the last three years, has been transferred to Madill, Oklahoma. He will be succeeded by C. V. QUINN, who has been transferred from Madill.

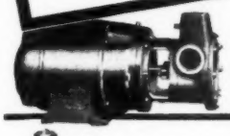
RAY H. SMITH, formerly with the Continental Supply Company, has joined the Texoma Supply Company, Tulsa, Oklahoma, as sales representative, it was announced by CARL J. HOCKENAUER, president of the firm. A representative with Continental seven years, Smith's territory included Oklahoma and Kansas.

J. J. ARPS has been transferred to Tulsa, Oklahoma, as chief engineer for The British American Oil Producing Company. Previously he was production superintendent for the company in the Gulf Coast division with headquarters in Houston, Texas.

JOHN I. YELLOTT has been appointed full time director of the Institute of Gas Technology at Illinois Institute of Technology. He has been chairman of the department of mechanical engineering and director of war training at Illinois Tech. He will also take on the duties of educational director of the Gas Institute. The Institute was established to provide a research and educational service for the gas industry and has expanded to an annual budget of $200,000.

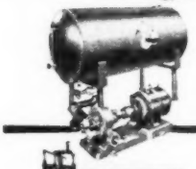
Westco PUMPS
Serve All Industries Large and Small

There is a size and type of Westco unit to meet important water moving requirements in practically every industry. Among the wide range of Westco equipment, the following are typical:

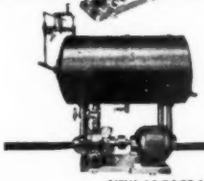


THE WESTCO UNIBILT PUMP
...an extremely compact, rugged pump for general purpose applications at low and medium heads. Ideal as sump pump, pressure pump, circulating pump, etc., where space is a limitation. Capacities to 100 GPM. Heads to 300 ft. Both self-priming and non-self priming types.

THE WESTCO FLEXIBLE COUPLING PUMP
...recommended for general purpose applications at medium and high heads. Excellent for water supply service, heavy duty pressure and circulating work, etc. Capacities to 200 GPM. Heads to 500 ft. Self-priming and non-self-priming types. For hot and cold liquids.



WESTCO CONDENSATE RETURN UNIT
...returns condensate to boiler at highest possible temperature, effecting important fuel savings. Automatically compensates for extreme head variations, assuring positive return against fluctuating pressures. Compact, rugged. Sizes to 100,000 sq. ft. of radiation. Pressures to 150 lbs.



WESTCO BOILER FEED UNIT
...insures uniformly-even boiler feed to maintain highest possible boiler temperatures with minimum firing. Automatically maintains uniform water level and steam space in the boiler, increasing boiler efficiency. Internal Make-up type for boilers to 25 HP. External Make-up for boilers to 750 HP.

NEW 64-PAGE WESTCO CATALOG. SEND FOR YOUR FREE COPY.

JOSHUA HENDY IRON WORKS
Pomona Pump Co. Division
2621 Locust Avenue, St. Louis 3, Missouri

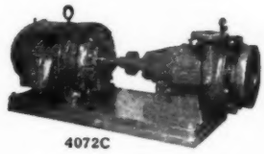
RESULTS FOR SALE!

We believe the cost of production on any lease can be lowered with JENSEN Pumping Units. We believe you'll think so, too, if you'll investigate. We're selling RESULTS, backed by time and experience — 25 years of both.

JENSEN
BROTHERS MFG. CO.
Coffeyville, Kansas, U. S. A.

Export Office: 50 CHURCH STREET, NEW YORK CITY

CENTRIFUGAL PUMPS RECIPROCATING



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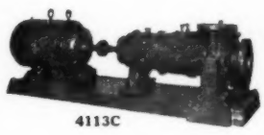

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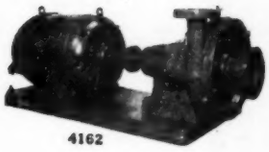

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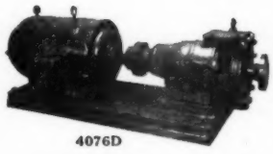


4076D

4127B

The national synthetic rubber production is expected to reach over 240,000 tons at the end of 1943.

Our centrifugal pump is on the job in several different plants helping make this production possible.

Cuts are photographs of a few of the different pumps of which we have many duplicates that are operating at this time in synthetic rubber plants.

We are proud to be participating in something so vital to our war effort.

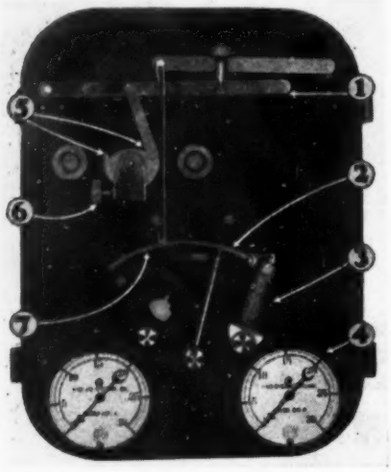
ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.
INDIANAPOLIS IND.
323 W. TENTH ST.

MACHINERY and EQUIPMENT

Level Control Pilot

THE new Hanlon-Waters Type 1410 level control pilot is especially designed to meet requirements



for a level control pilot having a very wide "throttling range," exact in its relation to the specific gravity of the liquids handled in the system, according to the manufacturers, Hanlon-Waters, Inc., Tulsa, Oklahoma. It is important for indicating or recording level service where the displacement float is used to indicate position of level in vessels where highly corrosive liquids make continuous use of gauge glasses impossible.

Wide throttling range settings are most important for even-flow characteristics where surge impulse elimination raises efficiency and makes for better control of the system. "Snap-action" settings are easily made without additional parts or special tools, if "on-off" action of control valve is desired, it is stated.

The H-W Type 1410 level control pilot is for use in the refining, chemical, synthetic, gasoline, recycling, and power industries. Features are as follows: (1) Specific gravity index scale setting from 0.10 to 2.0; (2) wide throttling range adjustment from zero to 300 percent, setting in exact relation to specific gravity setting; (3) long life bellows, operating throttle arm; (4) straight line pilot characteristic of pressure output to diaphragm vs. level variation; (5) simplified reversibility; (6) adjustment for height of level control, and (7) "snap-action" settings on pilot without use of additional parts or special tools. Other features are wide swinging door giving easy accessibility to all parts, mountable on any H-W Type 850 displacement level control and equipment including the popular H-W Type 245 supply medium regullator.

How Line Smashing Tanks Benefit Engine Design

Ingenuity and experience used in solving war machine clutch problems have produced new developments that will help American manufacturers protect future markets by designing better post-war products or re-designing present models. Don't struggle with power transmission problems affecting peace-time machines. Our engineers are ready to help productioneers plan more compact, dependable and efficient applications of

ROCKFORD *Industrial* CLUTCHES *and* POWER TAKE-OFFS

SEND FOR THESE HANDY BULLETINS ON POWER TRANSMISSION CONTROL

They tell and show how ROCKFORD CLUTCH and POWER TAKE-OFF applications are saving power, time and money in a wide variety of industries. Give capacities, dimensions and specifications.

Rockford Drilling Machine Division
Borg-Warner Corporation
1303 Eighteenth Ave., Rockford, Ill.

Fullmore Multiple-Disc Clutches • Over-Center and Spring-Loaded Clutches • Power Take-Offs

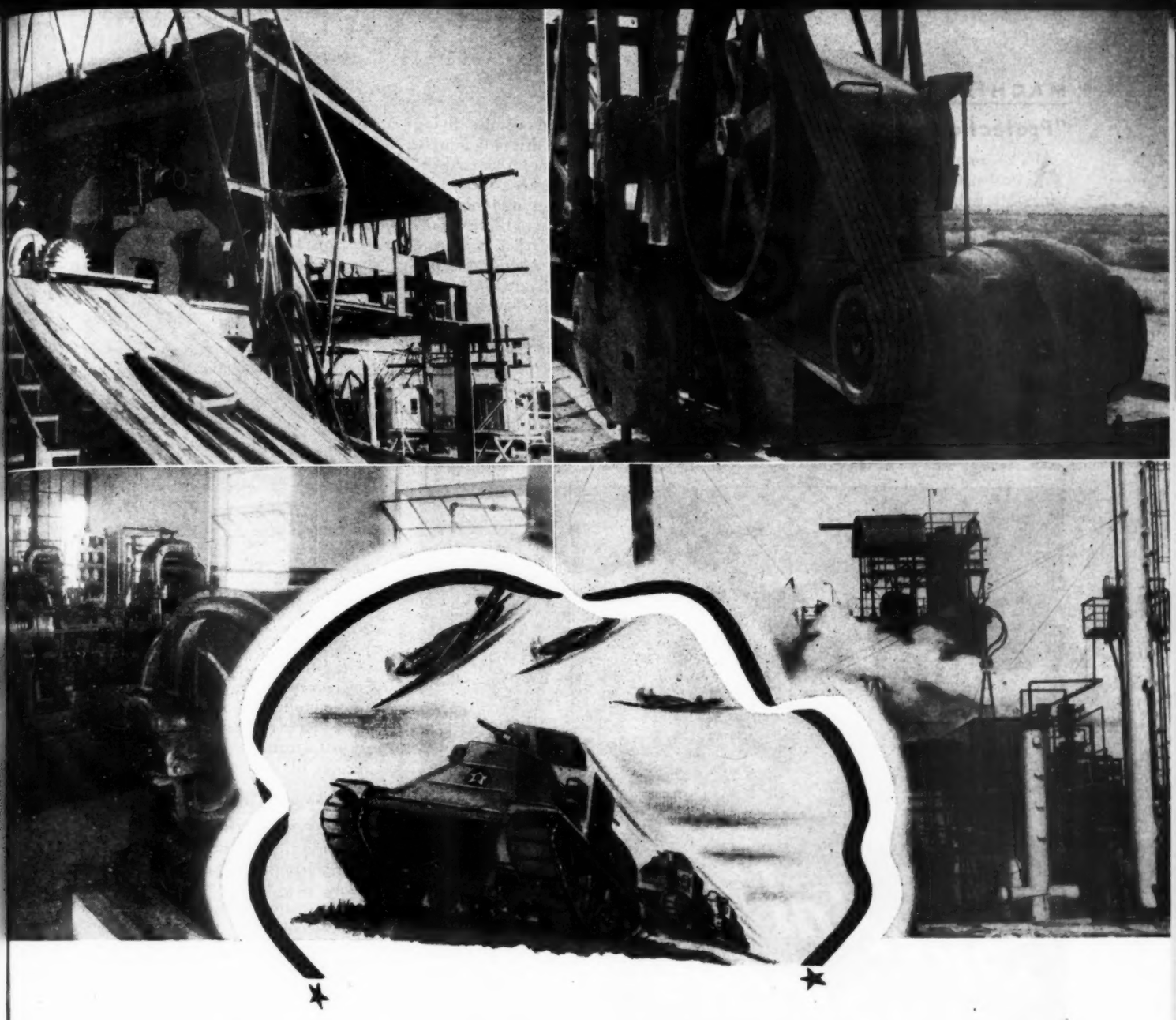
SPERRY-SUN

Sperry-Sun INSTRUMENTS Tell The Whole Truth

Accuracy and reliability are all-important in well survey. You either get a true record with a Sperry-Sun instrument or none at all. They are physically incapable of producing false records.

SURWEL Clinograph	H-K Single Shot
SYFO Clinograph	M-M-O Bottom Hole Orientation
E-C Inclinometer	K-K Whipstock
H-K Inclinometer	Polar Core Orientation

SPERRY-SUN WELL SURVEYING CO.
PHILADELPHIA, PA.
HOUSTON, TEXAS LONG BEACH, CALIF.



OIL! GASOLINE! That's What They Need

LET'S GIVE 'EM PLENTY OF THIS "FIGHTING POWER"

The Petroleum Industry is now being called upon to perform its greatest task . . . that of supplying sufficient quantities of oil and gasoline for invasion purposes. *An unprecedented assignment!*

By no measure of calculations can anyone figure precisely how much oil and gasoline will be needed to win this war, but the important factor is to give 'em all they need, when and where they need it, and without delay!

The Utility Electric Power Companies have and will continue to cooperate to their fullest extent toward this end. Through their foresightedness, they have planned for sufficient capacity, which will help produce all the "fighting power" needed. Just let us know when we can be of greater service. Our goal is VICTORY!

Use Utility Electric Power!

PETROLEUM ELECTRIC POWER ASSOCIATION

Box 1498 Oklahoma City, Oklahoma

"Protectioneered" Motor

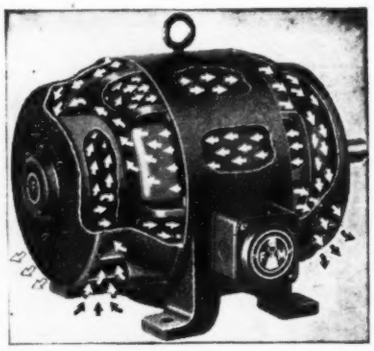
AFTER months of research and practical operation in the field, Fairbanks-Morse has now announced a new type, all-purpose, continuous-duty, polyphase squirrel-cage induction motor for use in all industries.

This new motor is "protectioneered" and, according to the company, embodies many special and vital features that will be viewed with extreme interest by motor users everywhere.

Constructed with the widely recognized and exclusive centrifugally-cast F-M Copperspun Rotor, this new motor is fully protected against flying chips, falling particles, dripping liquids, and other industrial motor hazards, it is stated. The ball bearings sealed in cartridge-type housings minimize expensive shut downs due to bearing failures. Cross-flow ventilation, a feature in frames 224 to 365, inclusive, is obtained by means of protected inlets and exhausts at each end of the motor, resulting in uniform cooling and the elimination of hot spots.

Regardless of the position of the motor, complete safety for the operator is assured because there are no moving external parts, it is asserted. The frame is cast in one piece with rib sections to add strength without increase in weight.

The new motor also incorporates an innovation in conduit boxes. Where space is limited, the conduit can be brought up between the motor feet to the tapped hole in the motor frame and the conduit box cover assembled flush with the frame. The external box is

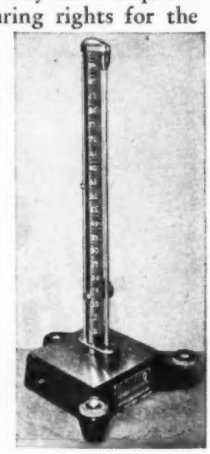


then discarded. When the conventional conduit box is used it can be mounted in any one of four positions.

Complete information and motor demonstration can be obtained by getting in touch with your local Fairbanks-Morse representative or by writing to Fairbanks, Morse and Company, Chicago, Illinois, for Bulletin No. 1160.

Acquires Rights to Bashore Resiliometer

Precision Scientific Company, 1750 North Springfield Avenue, Chicago 47, Illinois, announces they have acquired the sole manufacturing rights for the Bashore Resiliometer, formerly manufactured and sold by Testing Equipment Company, Manheim, Pennsylvania.



The instrument measures the resiliency of rubber and extensible plastic compounds by indicating the rebound of a weighted plunger dropped from a predetermined height. It has been found useful in the development of rubber and extensible plastic compounds, for measuring rate and state of cure, for matching competitive compounds, for factory control tests on cured samples of mixed batches, for factory control on uncured samples of mater-batches, for controlling the quality of the finished product without destroying the product, for comparing heat build-up of various compounds, and for measuring plasticity of uncured compounds and masticated rubber.

FOR SPECIAL JOBS ! - - - - - -

The AMERICAN line of Heavy Duty Roller Bearings is not limited merely to the standard types that have made AMERICANS famous the world over. *Special* Roller Bearings—such as the one illustrated,—include all the advantages of AMERICAN Heavy Duty Roller Bearings plus additional special features to meet your own specifications. Our engineering knowledge, resulting from years of Roller Bearing experience, is yours for the asking. Consult us about your special needs as well as for your more usual requirements.

AMERICAN ROLLER BEARING CO.
PITTSBURGH, PENNSYLVANIA
Pacific Coast Office . . . 1718 S. Flower St., Los Angeles, California

AMERICAN ROLLER BEARINGS HEAVY DUTY

AMERICAN
Heavy-Duty ROLLER BEARINGS

A. R. Zelt Promoted By Oil Well Supply

Election of Albert R. Zelt of Oil City, Pennsylvania, as ranking vice president of the Oil Well Supply Company, Dallas, Texas, U. S. Steel subsidiary, has been announced. Zelt's election occurred at a recent meeting of the board of directors of the company. He formerly was vice president in charge of manufacturing.

Zelt was graduated from Carnegie Institute of Technology in industrial engineering and mechanical engineering in 1923. He was employed as engineer in efficiency in the engineering department of the American Rolling Mills in 1923. In 1925, he entered the transportation business in Pittsburgh, eventually becoming vice president of the Pittsburgh Transportation Company.

A. R. ZELT

In 1931 he became manager of the service department of Oil Well Supply Company with headquarters at Oil City. Shortly thereafter he was made works manager, and in 1941 was elected vice president in charge of manufacturing.

He will make his future home at Dallas, Texas, where headquarters of the Oil Well Supply Company are located. Zelt is chairman of the Rotary Drilling Machinery Manufacturers' Committee of the American Petroleum Institute.

Jackson Appointed Director of Engineering

Duncan W. Fraser, president of the American Locomotive Company, announces the appointment of Lawrence B. Jackson as director of engineering, Diesel division, effective October 1.

L. B. JACKSON

Jackson is a graduate of Stevens Institute of Technology, and after association with the American Hawaiian S. S. Company as superintending engineer and with the Texas S. S. Company as plant engineer at the Bath, Maine, shipyard, and superintendent of technical division, marine department, he became associated with Fairbanks, Morse and Company in 1925. In this organization he advanced through the ranks from the position of engineer, marine applications, to the assignments of assistant chief engineer and chief engineer of the Diesel division, manager, marine Diesel sales, in Chicago, and manager, New England (sales) branch at Boston, to the position of manager of engineering in 1936.

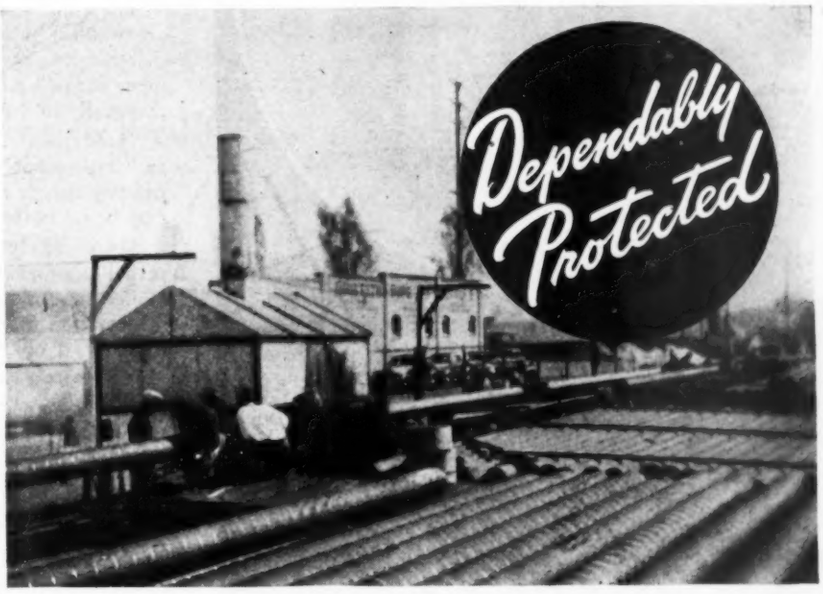
Made Chemical Engineer By Universal Atlas

Appointment of F. P. Diener, assistant general chemist of the Universal Atlas Cement Company, as chemical engineer for that organization, has been announced by officials of this United States Steel Corporation subsidiary.

Diener, a graduate of Lehigh University, joined the company's staff as an analytical chemist at the Northampton plant in 1924.

Actively engaged since that time in chemical, analytical, and engineering work, he was particularly concerned with the starting of operations at the plant of the Universal Atlas Cement Company at Waco, Texas.

Other appointments announced by the company included that of G. L. Lindsay, engineer of tests, to the position of assistant director of tests and research; and C. L. Davis, assistant engineer of tests, to engineer of tests.



With REILLY PIPE ENAMEL

★ Pipe lines coated with REILLY Enamel are exceptionally free from costly service interruptions. The tough, durable REILLY coating gives dependable protection against corrosion from all causes, is highly resistant to abrasion and soil stress, and is unaffected by extremes of temperature. The ability of REILLY Enamel to give dependable, low-cost protection under all conditions of service has been proved over a long period of years.

Booklet describing REILLY *Protective Coatings will be sent on request.*

Reilly COAL TAR PRODUCTS

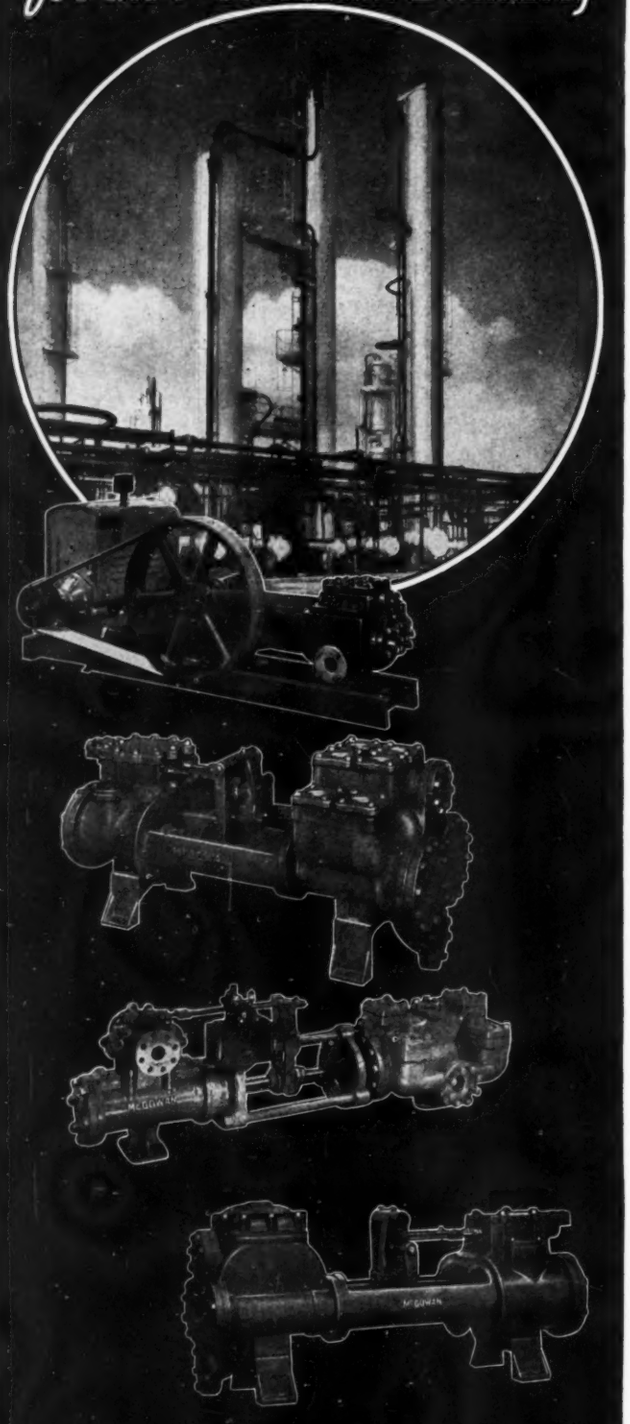
REILLY TAR & CHEMICAL CORPORATION

Executive Offices: Merchants Bank Building, Indianapolis, Indiana

2513 S. DAMEN AVENUE, CHICAGO, ILLINOIS · 500 FIFTH AVENUE, NEW YORK, N. Y. · ST. LOUIS PARK, MINNEAPOLIS, MINN.

SEVENTEEN · PLANTS · TO · SERVE · YOU

McGOWAN PUMPS
for the Petroleum Industry



The McGowan Pump Division of the Leyman Mfg. Corp., since 1852, has been famous for accurate workmanship and dependable service. An experienced Engineering department is available for information on installations and requirements. Highly efficient and ruggedly constructed McGowan Pumps have the ability to stand up year-in and year-out under severe service conditions.

McGOWAN PUMPS

LEYMAN MANUFACTURING CORP.
The JOHN H. McGOWAN Co. DIVISION
55 CENTRAL AVE. CINCINNATI, OHIO

Book Reviews

Studies in Arc Welding—Design, Manufacture and Construction. Published by The James F. Lincoln Arc Welding Foundation, Postoffice Box 5728, Cleveland, Ohio. Pages, 1295. Price, $1.50 postpaid in the United States, $2 elsewhere.

Ninety-eight outstanding papers on arc welding, submitted by trained technicians and engineers in The James F. Lincoln Arc Welding Foundation's 1940-42 Industrial Progress Award Program, have been edited and published in what is said to be the most comprehensive and complete collection of design studies on arc welding published since the Foundation's first volume was issued in 1939.

The volume is the result of the careful editing of papers on arc welding practice representing the work of 113 engineers, designers, works managers, superintendents, executives, foremen, and other technicians, each of whom applied himself individually to a specific design study involving arc welding.

Studies in Arc Welding will provide engineering, technical and trade schools with a tremendous amount of authentic arc welding design applications, together with welding data that may be translated into new applications.

There are 1007 illustrations, the majority of which are actual photographs of welding procedures. Each study includes designs, calculations, procedures, and other pertinent information that show how the advantages attributed to arc welding are obtained.

"One of the chief contributions that this volume will make in our industrial progress," the Foundation award jury states, "lies in what the studies point out as the economies of modern arc welding. Hundreds of millions in dollars could be saved by adopting arc welding in the design and manufacture of many steel products. *Studies in Arc Welding* makes available the knowledge of many engineers who support this view."

The contents of the book are arranged in nine sections with 98 chapters. Each chapter covers a specific design subject; each section covers a particular field. They are automotive, aircraft, railroad, water craft, structural, furniture and fixtures, commercial welding, containers, and machinery.

O-C-T Capitalization Increased

Oil Center Tool Company, Houston, Texas, manufacturer of drilling control and completion equipment for oil and gas wells, has increased its capitalization from $360,000 to $500,000, it was announced recently.

The increase, second in five years, is the result of the company's growing business, it was explained.

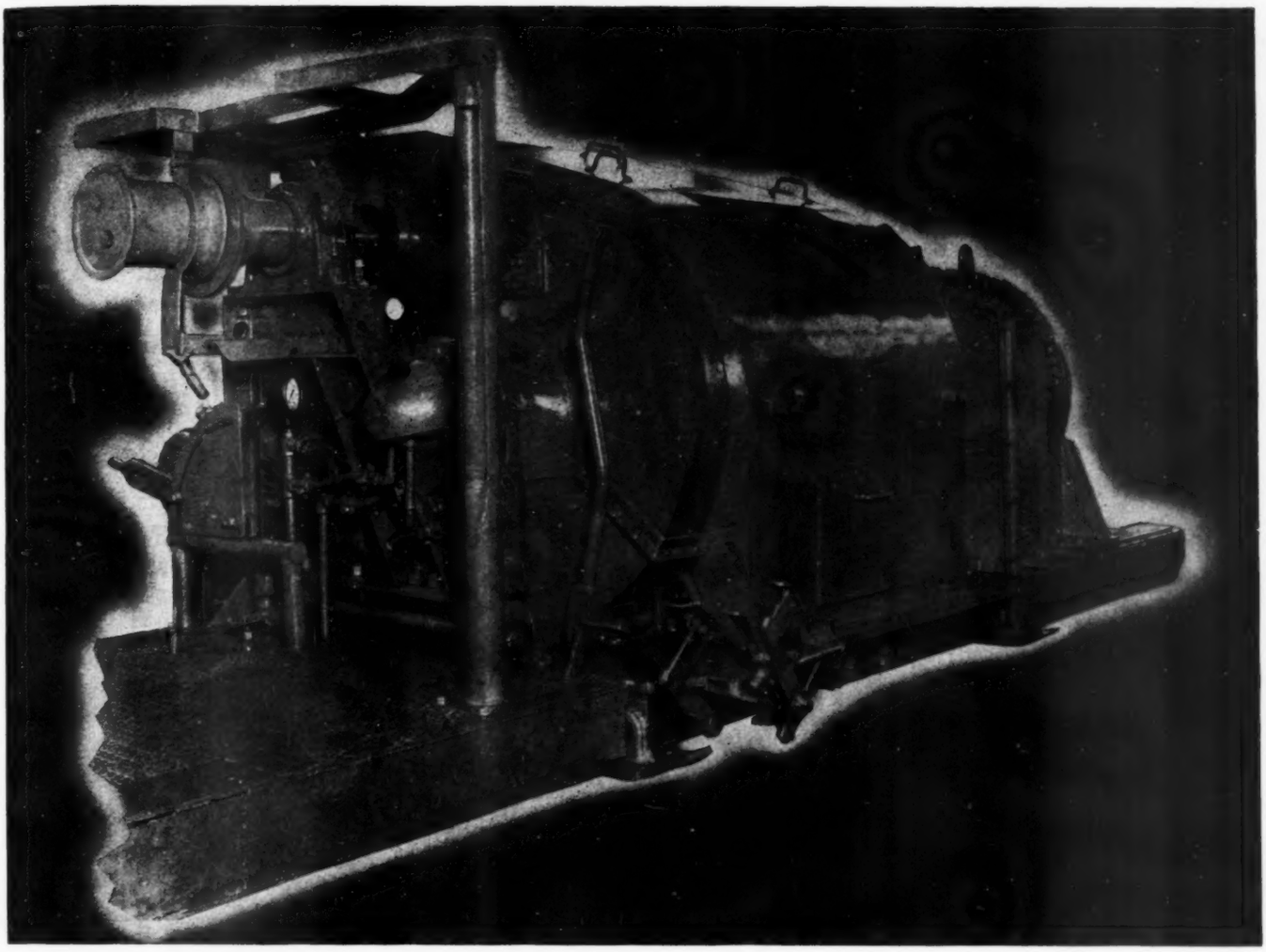
Officers of the company are A. J. Penick, president and general manager; H. D. Start, vice president and plant manager, and B. V. Fisher, secretary-treasurer.

J. L. Tildsley, Jr., Dies

John Lee Tildsley, Jr., manager of the Chicago branch of Reilly Tar and Chemical Company, Indianapolis, Indiana, died in Chicago September 26. He was 44 years old.

Tildsley attended Riverdale School and Exeter Academy and was graduated in 1919 from Harvard University. He served as a second lieutenant in the Coast Artillery in the first World War. In 1928 he joined the International Combustion, Tar and Chemical Company, and when that company was merged with the Reilly Tar and Chemical in 1933, Tildsley was sent to Chicago as manager for the Reilly organization.

Surviving are his parents and a sister.



Used Draw-works — RECONDITIONED LIKE NEW — *by Hunt*

For a fraction of the cost of a new draw-works, we can rebuild your old style unit into a modern, oil-bath draw-works, ready for new rig service. Changes, including all necessary replacements, made to your specifications.

The 9" draw-works pictured above was oil-bathed in our Houston plant. Our Jennings and Harvey, La., shops are also fully equipped for draw-works reconditioning.

"A BUSINESS BUILT ON SERVICE"

HUNT TOOL COMPANY

FIELD SHOPS:
Houston, Bay City, Corpus Christi, Jennings, Shreveport, Harvey

EXPORT SALES:
W-K-M Company, Inc.
74 Trinity Place, New York City

HUNT TOOL COMPANY
HOUSTON, TEXAS, U. S. A.

STOODY 6

Applied by Welding Reclaims Worn Valves

NOW worn valves, valve parts and pump sleeves can be reconditioned to outperform new factory parts by a simple oxyacetylene welding application using Stoody 6. This new Stoody alloy, composed principally of cobalt, chromium and tungsten, will not oxidize—even under intense heat, has high impact strength in relation to its hardness, offers excellent resistance to abrasive wear, and is perhaps the easiest of all hard-facing alloys to apply. Stoody 6 is highly efficient for hard-facing new or old internal combustion exhaust valves, gate, globe and angle valves, hot oil pump sleeves, etc.

Trial order of 10 lbs. of 3/16" diameter Stoody 6 at $4.25 per lb. will prove the merits of this alloy for any applications involving heat, corrosion, abrasion and impact. Available on AA-4 or higher priority rating.

STOODY COMPANY

1142 West Slauson Ave., Whittier, Calif.

STOODY HARD-FACING ALLOYS

Stop wear . . . Eliminate Repair

Steinkamp Promoted

W. H. STEINKAMP

W. H. Steinkamp has been appointed assistant general sales manager of the Brown Instrument Company, a division of Minneapolis-Honeywell Regulator Company. During the last 13 years Steinkamp represented the Brown company in New York, Buffalo, Cleveland, and Pittsburgh, where he served as branch manager. He will make his headquarters at the company's main office in Philadelphia, Pennsylvania.

Award Renewed

Beaumont Iron Works Company, Beaumont, Texas, recently received notice from C. C. Bloch, Admiral, U. S. Navy, chairman of the Navy Board for Production Awards, to the effect that the board had granted a renewal of the company's Army-Navy "E" Award for an additional period of six months dating from July 29, 1943.

Beaumont Iron Works Company was awarded the Army-Navy "E" for outstanding production of war material on February 12 of this year.

Record Recognized

For many years the Jersey City shops of The M. W. Kellogg Company have been fabricating heat transfer equipment. Early in the Liberty ship program, this plant was designated by the U. S. Maritime Commission to build main condensers for Liberty ships. The one-thousandth condenser was completed and shipped during the last week in August.

The first of these units were fabricated and assembled in a remarkably short time. Since then the Jersey City plant has worked continuously to produce these condensers to meet the schedules of the Maritime Commission, a schedule that has involved shipment of as many as 100 condensers in one month. These shipments were for many points in the United States. For instance, of the first ten condensers completed, five were shipped to the Pacific Coast and five to the Atlantic Coast.

Shipment of the one-thousandth condenser represents the speediest and greatest amount of main condenser heating surface ever completed in any plant in the country, officials of the company assert.

Recognition for this outstanding production achievement was made by the United States Maritime Commission with the award of the "Gold Star" to The M. W. Kellogg Company.

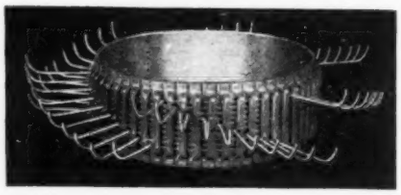
For a

CLEAN WELL

use

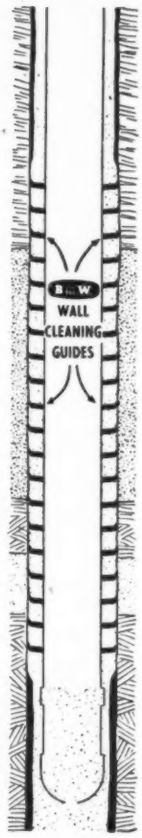
B and W, Inc.

WALL CLEANING GUIDES



. . . and MOVE THE CASING WHILE CEMENTING

By mounting B and W Wall Cleaning Guides on the casing slightly below, through and above the productive sections which are to be gun perforated, continuous centering is assured throughout these critical sections. The strong, torque spring action of the multiple wires forming the guides holds the casing definitely in the center of the hole.



By raising and lowering the guide-equipped casing while circulating and cementing, the annulus between the casing and formation is freed from rotary mud and mud cake, and a perfect bond is secured between cement and formation.

B and W Wall Cleaning Guides . . . (1) Scratch off Mud Cake; (2) Center the Casing; (3) Prevent Channeling, and (4) Increase Successful Completions.

BRUCE BARKIS — **B and W, Inc.** — KENNETH WRIGHT

Well Completion Specialists

WEST COAST

3545 CEDAR AVENUE
LONG BEACH, CALIFORNIA
TELEPHONE: LONG BEACH 4-8366

GULF COAST

305 M. AND M. BUILDING
HOUSTON, TEXAS
TELEPHONE: PRESTON 9783

Rowan Heads Drillers

A. H. Rowan, Houston and Fort Worth, Texas, drilling contractor, was elected president of the American Association of Oil Well Drilling Contractors at the annual convention in Houston this month. He succeeds N. H. Wheless.

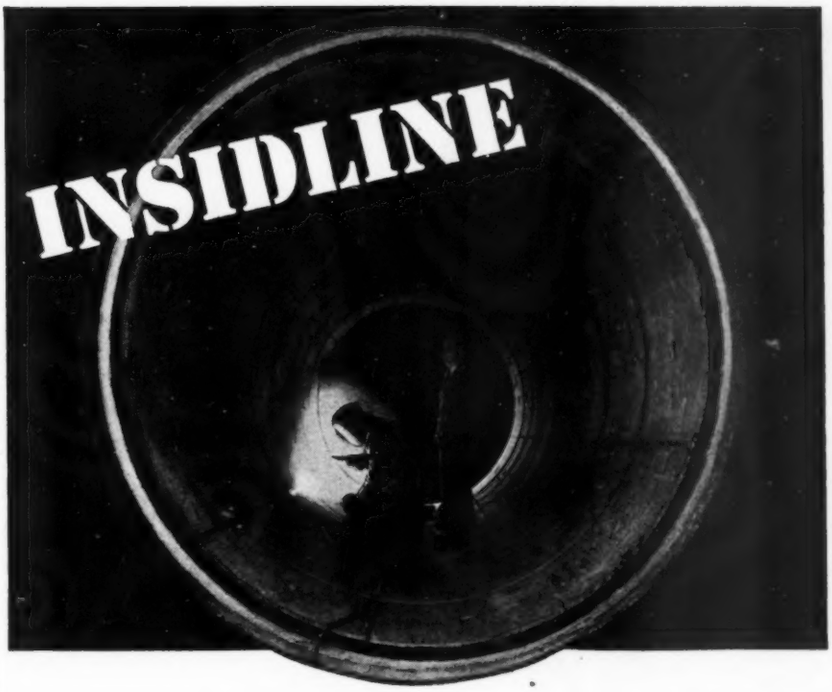
Other officers named were: H. L. Sullivan, Tulsa, Oklahoma, vice president at large; J. E. Warren, Midland, Texas, vice president for rotary tools; Ben M. McGraw, vice president for cable tools; John Chapman, Houston, vice president for the Gulf Coast; Harry S. Connelly, Wichita, Kansas, vice president for Rocky Mountains; Cyrus Bell, Los Angeles, vice president for California; C. M. Ashby, Grand Haven, Michigan, vice president for Illinois and Michigan; K. B. Knox, Houston, vice president for well servicing; Harry W. Bass, Dallas, treasurer, and Brad Mills, Dallas, secretary.

Discuss Postwar Program

Field executives, company engineers, and management personnel of Kobe, Incorporated, recently attended a meeting of all Mid-Continent division executives at division headquarters in Oklahoma City, Oklahoma. The meeting was called for the purpose of reviewing technical and operating developments during the previous year and laying groundwork for the company's postwar program.

Factual information from the field organization as it pertained to the use of the company's hydraulic pumping system and its importance to pumping operations in the war and postwar period, were principal topics.

Members of the organization attending the meeting were: H. K. Browning, general sales manager; S. M. Huffman, plant manager, and R. F. McArthur, chief engineer, from the company's home office at Huntington Park, California. Others in attendance were: V. T. Kirkhuff, chief sales clerk, division sales office; W. C. Gilmore, district manager, East Texas district; W. L. Smith, stores manager; E. O. Layman, field engineer; R. J. Lyons, district manager, North Texas district; C. E. Edwards, field representative, Wichita Falls, Texas; J. S. Williams, division office manager; H. W. Wilson, district manager, Oklahoma district; E. T. Harrison, district manager, Illinois district; J. J. Prichard, district manager, Kansas district; C. E. Buchner, district manager, Gulf Coast district; M. L. Walraven, Jr., district manager, Tulsa district; R. A. Hammond, purchasing agent; R. A. Feemster, division sales manager; R. G. Ralph, division manager, and H. K. Ihrig, manager technical service department.



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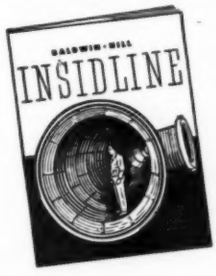
Standard carbon steel pipe begins to lose strength rapidly at temperatures above 650° F. By the time working temperatures of 1000° F are reached, allowable stresses must be lowered radically.

Insidline is the practical answer to industrial processes that require the use of piping under these conditions. Insidline eliminates the necessity of making costly special pipe. It makes it possible to design pipe systems with much less expensive, and less elaborate, allowances for expansion. In many cases, it replaces external insulations.

Installations in pipe 36" I.D. and under, are made with a cartridge type Insidline that is assembled first and then drawn into the pipe. In larger diameters, a panel type is used which is actually built-up on the inside of the pipe. In both types, the insulation liner is held in place without excessive hot-spots on the outer pipe, and with proper allowances for expansion and contraction.



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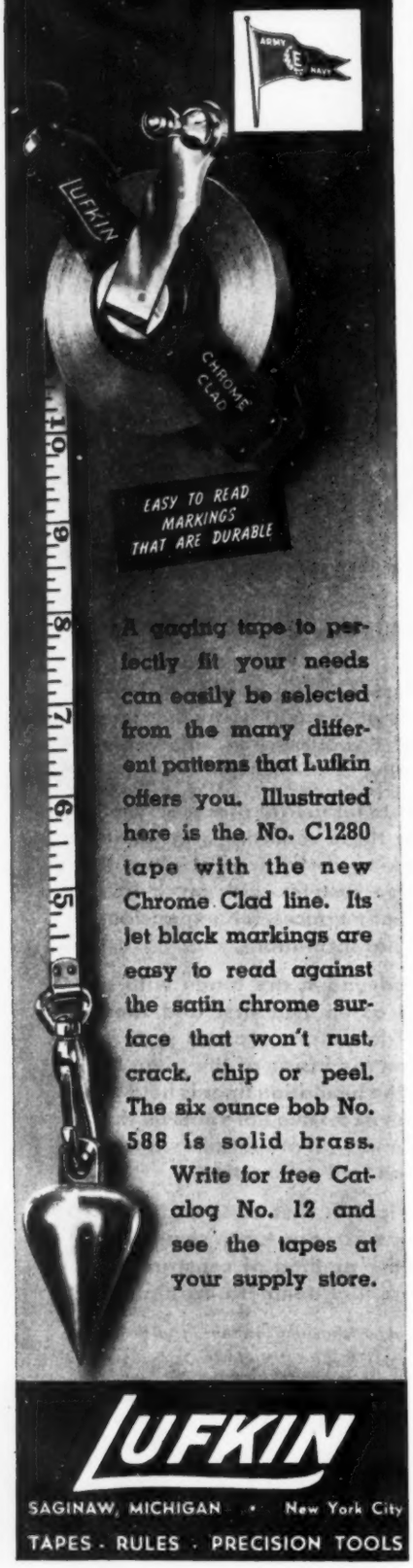

A gaging tape to perfectly fit your needs can easily be selected from the many different patterns that Lufkin offers you. Illustrated here is the No. C1280 tape with the new Chrome Clad line. Its jet black markings are easy to read against the satin chrome surface that won't rust, crack, chip or peel. The six ounce bob No. 588 is solid brass. Write for free Catalog No. 12 and see the tapes at your supply store.

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TAPES · RULES · PRECISION TOOLS

Dr. Scott to Staff of Industrial Engineering Co.

Dr. Gordon N. Scott, consultant in corrosion mitigation, has joined the executive staff of Industrial Engineering Company in the capacity of consulting engineer in charge of research and development. Industrial Engineering Company is the manufacturer and applier of Somastic pipe coating. Central

GORDON N. SCOTT

plants are maintained at Houston, Texas, and Wilmington, California, with offices at Houston, Wilmington, Bartlesville, Oklahoma, Los Angeles, and San Francisco.

Dr. Scott has been engaged continuously in research concerned with corrosion prevention since April, 1928. After earlier activities in Hawaii and as research chemist for The Mid-Continent Petroleum Corporation, Dr. Scott in 1928 was appointed research associate at the National Bureau of Standards, Washington, D. C., in conjunction with the study of corrosion mitigation and nationwide tests of protective coatings instituted by the Corrosion Committee of the American Petroleum Institute. This work occupied him until December, 1934, after which he served the corrosion committee of the A. P. I. as pipe line technologist, making his headquarters at Dallas while correlating information on pipe line corrosion for the Institute.

Since January, 1936, he has been a consulting engineer with headquarters in Los Angeles.

Heads Pittsburgh Divisions

The appointment of Thomas I. Phillips, vice president of the Westinghouse Electric and Manufacturing Company, as head of the company's Pittsburgh divisions has been announced by George H. Bucher, president of the company. Phillips, who entered the employ of Westinghouse in 1915 as a tool maker, succeeded A. C. Streamer who was named assistant to the president.

Tube Turns Opens Offices

Opening of two new West Coast offices for Tube Turns, of Louisville, Kentucky, has been announced. T. H. Pike, Jr., district manager for the Pacific Coast area, may now be reached at 2611-12 Russ Building, San Francisco.

Since October 15 a second office has been maintained in Room 422-A, Smith Tower Building, Seattle 4, Washington. In this office John M. Hartley, formerly of the Los Angeles office, will handle matters pertaining to Washington, Oregon, and British Columbia. The telephone is Main 2778.

The Los Angeles office was closed October 15.

To Houdry Process Corp.

Eugene J. Houdry, president Houdry Process Corporation, announces the appointment of Frank P. Tighe as director of public relations and advertising for the Houdry Process Corporation, Wilmington, Delaware.

Tighe already has assumed his new duties after spending a year and a half in the Press Division of the Office of Censorship, Washington, D. C., handling advertising and articles on industrial subjects.

Born in Colwyn, Pennsylvania, 39 years ago, Tighe was educated in the Philadelphia schools. His earlier experience included 12 years on the advertising and editorial staffs of the Chilton Company, publishers of business papers. Tighe also has worked as publicity representative for Roche, Williams and Cunnyngham, Inc., advertising agency, handling public relations for the Studebaker Corporation and Bendix Automotive Products Corporation. Before going to the Office of Censorship upon its establishment, he had been general manager of the Philadelphia Automobile Trade Association.

Third Renewal Navy "E"

Among the first to receive the Navy "E" early in 1942, Farrel-Birmingham Company, Inc., has received its third renewal for continued excellence in the production of equipment for the Navy.

Each of the company's three plants, at Ansonia and Derby, Connecticut, and Buffalo, New York, is now privileged to fly the Navy "E" burgee with three white stars, indicating the receipt of this award for four consecutive six-month periods.

Cletrac Receives Army-Navy "E" Award

For excellence in production and outstanding production achievement, the personnel of The Cleveland Tractor Company, Cleveland, Ohio, was awarded the Army-Navy "E" at a colorful and impressive ceremony.

The award was conferred in recognition of the company's noteworthy contribution to the war effort, not only in the development and production of specialized crawler tractors built for the Air Corps, but for outstanding production of its standard product as well as the parts for tanks, Bofor anti-aircraft guns, and half-trac cars.

It is interesting to note that The Cleveland Tractor Company as far back as 1922 had perfected a high-speed military crawler vehicle, and has worked on similar vehicles since that time. Long before Pearl Harbor the Cletrac plant was in production of high-speed tractors, and after Pearl Harbor the company went out 100 percent for war work.

The presentation of the "E" award was made by Lt.-Col. T. H. Eichoff and received by L. H. Grutsch, works manager, and V. O'Neal, representing employees.

The "E" pins were presented by Lt. Commander J. P. Sturgis of the U. S. Naval Reserves, assisted by Sgt. Arthur E. Sizer, U. S. Army, a veteran of the African campaign, now on sick leave.

The "E" pins were accepted by a group of five of the oldest employees. Frank J. Lausche, Cleveland's mayor, introduced the speakers.

Westinghouse Official

Election of Gwilym A. Price, of Pittsburgh, as a vice president of the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pennsylvania is announced.

Price was formerly president of the Peoples-Pittsburgh Trust Company. At Westinghouse his responsibilities will include settlement of war contracts.

Years Don't Determine Boiler Age or Efficiency

Young boilers may be old—old boilers may be young. Scale and corrosion cut their life and efficiency.

SAND-BANUM

keeps them young and productive. It removes and prevents scale and corrosion in absolute safety while your equipment operates.

It can be "professionally" applied by a novice, regardless of water or operating conditions. Water analyses are obviated and time-out for shut-downs diminished.

Data on many years of successful use by outstanding companies is yours on request, and without obligation.

"The Entirely Different Boiler and Engine Treatment"

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MULTIPLE DRIVE BELTS — MATCHED SETS

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Belt Sizes A WIDTH	Belt Sizes B WIDTH	Belt Sizes C WIDTH	Belt Sizes D WIDTH
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A-31	B-46	C-60	D-128
A-35	B-51	C-68	D-144
A-38	B-55	C-75	D-158
A-42	B-60	C-81	D-162
A-46	B-68	C-85	D-173
A-51	B-75	C-90	D-180
A-60	B-81	C-96	D-195
A-68	B-85	C-105	D-210
A-75	B-90	C-112	D-240
A-80	B-97	C-120	D-270
A-85	B-105	C-128	D-300
A-90	B-112	C-144	D-330
A-96	B-120	C-158	D-360
A-105	B-128	C-162	E WIDTH
A-112	B-144	C-173	E-180
A-120	B-158	C-180	E-195
A-128	B-173	C-195	E-210
	B-180	C-210	E-240
	B-195	C-240	E-270
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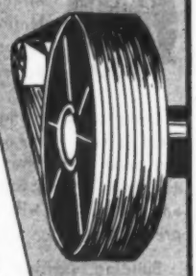
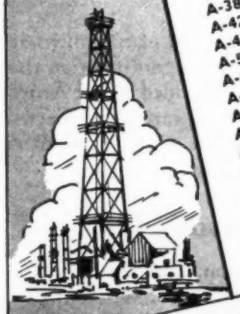
	B-300	C-360	





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Furnish Details of Your Requirements . . . Prompt Quotations . . . Immediate Deliveries

CARLYLE RUBBER CO., INC.

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THREE FULLY PROVEN FEATURES

The post-war era may be years—or only a few short months away. The tides of battles and Nations are running faster and faster. Peace may fall upon us with a shattering suddenness. In the less hurried days of peace, the buying of machinery and equipment is sure to be upon a more keenly exacting basis. It is then that Layne's three great and fully proven features—Quality, Efficiency and Reliability, will reach new heights of appreciation.

Building Turbine Pumps and Well Water Systems requires skill, patience, knowledge and experience. In all of these attributes, Layne leads the world. That leadership is today, and has long been many times greater than that of any competitor. Such a record cannot be discounted.

Layne Turbine Pumps and Well Water Systems are built with the utmost precision and from the world's finest and most practical materials. They offer the highest in efficiency, longest years of life, lowest upkeep cost and the most reliable service.

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AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Texas Co., Houston, Texas ★ Layne-Western Co., Kansas City, Mo. ★ Layne-Western Co. of Minnesota, Minneapolis, Minn. ★ International Water Supply Ltd., London, Ontario, Canada.

LAYNE
WELL WATER SYSTEMS
DEEP WELL PUMPS

Builders of Well Water Systems for every Municipal and Industrial Need

Oil Well Supply Again Honored

Continued good work in the production of war equipment for our armed forces has won new Army and Navy recognition for the men and women at Oil Well Supply Company's Imperial Works, Oil City, Pennsylvania.

Headquarters for Oil Well Supply Company are at Dallas, Texas. Fred F. Murray of Dallas recently was elected president of the company.

A letter from Under Secretary of War Robert P. Patterson informed the employees at this U. S. Steel plant that they had received for the second time the Army-Navy Production Award "for meritorious services on the production front."

"You have maintained the high standard that you set for yourselves and which won you distinction more than six months ago," his message said in part. "You may well be proud of your achievement."

The white star, which the renewal adds to the plant's "E" pennant, is a symbol of appreciation from the men and women in uniform for the continued and determined effort and patriotism shown by workers on the home front.

Responding to Under Secretary Patterson's letter, E. H. Roos, Imperial Works manager, said on behalf of the plant:

"The employees and management are proud of receiving the notification that a white star is to be added to our Army-Navy Production Award flag. We will continue our earnest efforts to merit an additional white star."

J. V. E. Dickson Dies

J. V. E. Dickson, engineer with E. B. Badger and Sons, Boston, Massachusetts, for the last 17 years, died of a heart attack, September 28, in Cleveland where he had been since July, 1942, in connection with work being done in the field of aviation gasoline.

Prior to going to Cleveland, Dickson had designed and operated plants for the petroleum industry in various parts of the United States, in Mexico, and in England.

Born in 1894 at Wroxeter, Ontario, Dickson had received his final papers as a naturalized citizen of the United States only a few days before his death.

He was a graduate of the University of Toronto and during World War I was connected with the Bethlehem Steel Company.

Dickson was a member of the American Chemical Society and the American Institute of Chemical Engineers.

Burial was October 1 in Cleveland.

Look for the Arm-and-Hammer

ARMSTRONG BROS.
CHAIN TONGS

ARMSTRONG CHAIN TONGS have been engineered to overcome the weaknesses discovered in ordinary tongs. They are stronger, last longer and are more convenient.

Jaws are drop forged, with milled teeth, are heat-treated and extremely tough. They have inner lugs which increase the bearing on the bar and also prevent chains from jamming. Other strength features include forged handles, large hardened steel bolts, alloy steel shackles and proof-tested chains.

ARMSTRONG BROS. Tongs come in *all* standard types, each in *all* sizes.

Write for Catalog.

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"The Tool Holder People"
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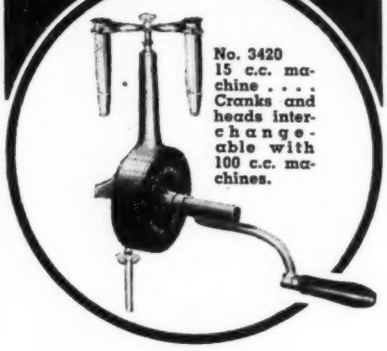
For QUICK, ACCURATE TESTS
Use CURTIN CENTRIFUGES



No. 3420 15 c.c. machine . . . . Cranks and heads interchangeable with 100 c.c. machines.

Simple in design . . . Ruggedly built . . . Require no special care . . . Great Ratio and throw of crank produce required speed with no strain. Curtin Centrifuges meet all *A.S.T.M. Standard Method D-96-40* and *A.P.I. Code No. 25* requirements. Fully descriptive literature upon request.

W·H·CURTIN & CO. Inc
HOUSTON TEXAS

New Valve Plant in Operation

Completely equipped with the most modern precision equipment for the manufacture of cast-steel valves, in keeping with the exacting standards of design and construction maintained by the company since its inception sixty years ago, the new plant of the Ohio Injector Company at Wadsworth, Ohio, now is in full production.

The new plant contains a quarter million square feet of floor space. Production includes the complete range of gates, globes, angles, and checks in the 150 lb. series, with the 300 lb. series soon to be in production, followed by valves in the 400 and 600 lb. series.

All OIC cast steel valves feature the same design and construction as standard OIC bronze and iron valves, and in addition, stress an important and exclusive patented OIC feature that facilitates repacking under pressure.

The new OIC executive office building at Wadsworth, also recently completed, flies the first Army-Navy "E" flag awarded for outstanding achievement in the production of war goods.

Jack Knebel Promoted

Southern Supply Incorporated, of Wichita, Kansas, announces the appointment of Jack A. Knebel as general manager of the Process Equipment Division of Southern Supply Incorporated, Tulsa, Oklahoma. For the last five years Knebel has been general manager of the Resale Products Department of the Joseph A. Coy Company.

J. A. KNEBEL

The Process Equipment Division is a new department of equipment and engineering service established by Southern Supply Incorporated. As a member of the firm Knebel will offer to Mid-Continent purchasers a complete line of process equipment, together with general supply lines. He will act in an engineering capacity to all departments of Southern Supply involving process and mechanical equipment problems. The Process Equipment Division will represent a number of nationally known petroleum industry equipment manufacturers.

Appointments Announced

John Hauerwaas, newly appointed president of United States Steel Products Company, formerly Boyle Manufacturing Company, announces organization changes in this U. S. Steel subsidiary, including appointments to executive positions.

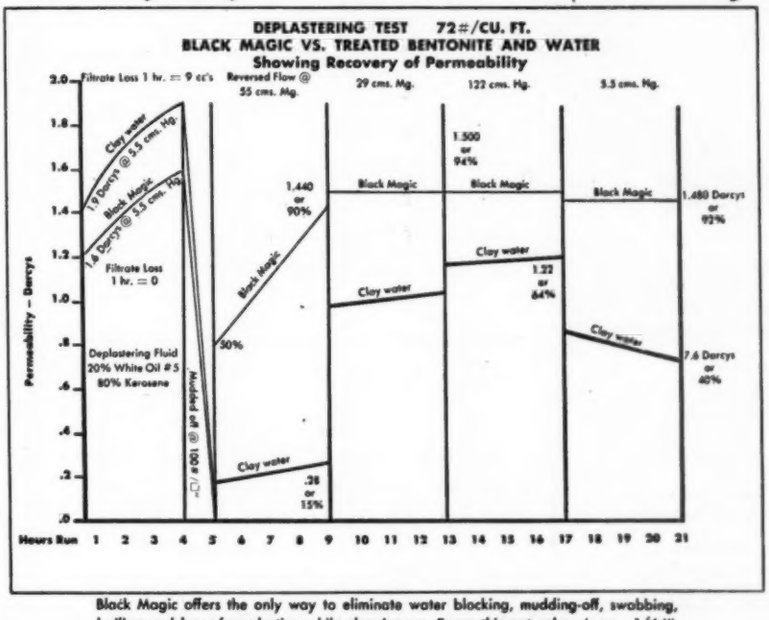
The plants formerly operated by Boyle Manufacturing Company are now operated by the Boyle Manufacturing Divisions of United States Steel Products Company. The plants recently acquired from The Petroleum Iron Works Company near Sharon, Pennsylvania, and at Beaumont and Port Arthur, Texas, are now operated by the Petroleum Iron Works Division of United States Steel Products Company.

The appointments announced were those of T. McGahan, vice president and general manager of sales and A. E. Klieves as vice president in charge of operations of the Boyle Manufacturing Division. At the same time J. A. Connelly was appointed vice president and general manager and William I. Hanrahan, vice president of the Petroleum Iron Works Division.

On or about November 1, 1943, temporary executive offices will be established by the United States Steel Products Company at 30 Rockefeller Plaza, New York City.

WATERLESS DRILLING

The only way to eliminate water blocking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Showing Recovery of Permeability
Permeability – Darcys
Hours Run
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Reversed Flow @ 55 cms. Hg.
29 cms. Hg.
122 cms. Hg.
5.5 cms. Hg.
Clay water
1.9 Darcys @ 5.5 cms. Hg.
Black Magic
1.6 Darcys @ 5.5 cms. Hg.
Filtrate Loss 1 hr. = 0
Deplastering Fluid 20% White Oil #5 80% Kerosene
Mudding off @ 100#
1.440 or 90%
1.500 or 94%
1.480 Darcys or 92%
1.22 or 64%
.38 or 15%
7.6 Darcys or 40%
30%

Black Magic offers the only way to eliminate water blocking, mudding-off, swabbing, bailing and loss of production while cleaning up. Forms thinnest cake, + or −1/64".

OIL BASE DRILLING FLUIDS CO., 1616 Santa Fe Ave. 21, Los Angeles, Calif.

BLACK MAGIC

OIL BASE DRILLING FLUID

FROM WASHINGTON

Closer Well Spacing Permitted

Greater development of oil fields in 12 southwestern Michigan counties will be possible as a result of an order issued by Petroleum Administrator for War Harold L. Ickes.

In an amendment to a formal order (Supplementary Order No. 7, amended, to Petroleum Administrative Order No. 11), closer oil well spacing patterns are permitted with a view to increasing the number of producing wells in that section.

The administrator said that the action was taken to provide additional production capacity close to the important refining, industrial, and consuming centers of the middle west.

He also pointed out that under the closer spacing provisions of the amended order, operators will find it easier to develop their oil properties, as the producing formations in southern Michigan are in most instances irregular.

Highlights of the order, as outlined by Deputy Administrator Ralph K. Davies, are:

The supplementary order continues to affect producers in Allegan, Barry, Berrien, Branch, Calhoun, Cass, Kalamazoo, Kent, Muskegon, Ottawa, St. Joseph, and Van Buren counties, Michigan.

An oil well may be drilled on a 10-acre tract, provided the well does not exceed 1,400 ft. in depth. Previously the order established a 20-acre spacing pattern for wells of 2000 ft. or less.

If an oil well is drilled to a depth of 1400 to 2500 ft., a 20-acre spacing pattern will prevail.

The 40-acre spacing pattern (as defined in Petroleum Administrative Order No. 11) will apply to all wells drilled to depths greater than 2500 ft. This provision will not affect present operations, however, as no fields in the affected counties produce at those depths.

Now, a well may be drilled at a point 300 ft. from the nearest unconsolidated properties. Previously, a 330 ft. limit was required.

Priorities Assistance Given on Casing and Tubing

Oil operators in Illinois and parts of Indiana and Kentucky may now use priorities assistance in obtaining casing and tubing to be used in drilling and completing wells that conform to the provisions of Supplementary Order No. 5 to Petroleum Administrative Order No. 11, under the terms of an amendment to Supplementary Order No. 5, issued by the Petroleum Administration for War.

Formerly such wells could be drilled only if casing and tubing were from stocks on hand or were acquired without the use of priorities assistance. Priorities assistance has always been permissible for obtaining materials other than casing and tubing and this provision remains unchanged.

The amended order also eliminates the necessity of filing certain completion reports required for wells drilled pursuant to the order.

Supplementary Order No. 5 to PAO No. 11 has replaced the provisions of the former War Production Board M-68-5, but many operators in the affected area still refer to it as M-68-5.

HANDS THAT WILL COME BACK

War scarred hands—deserving hands—will be coming back.

It is our job, and your job, to see to it that those hands that protected us do not suffer the humiliation of idleness.

HILL-HUBBELL'S postwar plans are being readied for action!

As always, since our beginning in 1928, we shall continue to provide you with Steel Pipe Protection of real quality.

HILL-HUBBELL Steel Pipe Protection is applied at these leading mills:

Jones and Laughlin Steel Corporation

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GENERAL PAINT CORPORATION
HILL, HUBBELL & CO. • Division • Cleveland, Ohio
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Petroleum Industry Asked For Scrap Metal

Petroleum Administrator for War Harold L. Ickes has called upon the oil industry to contribute at least 180,000 tons of scrap metal to the national scrap pile during the three months' period ending in December.

The request was made in conjunction with the salvage drive that began on October 1 under the direction of the salvage division of the War Production Board.

In a statement addressed to all branches of the petroleum industry, Administrator Ickes said:

"The War Production Board is now conducting a salvage drive to collect 9,800,000 tons of industrial scrap metal to assure a steady flow of scrap iron and steel to the mills. At least 180,000 tons must come from the oil industry.

"Petroleum operators know the importance of maintaining stocks of materials for essential operations. It is only proper that the industry provide its share of scrap to the victory scrap banks being established throughout the country.

"I have no doubt that the oil industry will do everything possible to meet its quota of 180,000 tons of scrap for the last three months of 1943."

Deputy Administrator Ralph K. Davies said that the petroleum industry should have no difficulty in meeting its quota. He pointed out that in July oilmen had collected 42,600 tons of scrap metal.

Davies said:

"If the industry can contribute that much scrap metal to the salvage drive in one month—a month in which no special effort was made to find scrap—then there should be little difficulty in collecting at least 180,000 tons for the three-months' period ending next December."

Nomads Hear Interesting Speakers

Postwar conditions and naval action in the Pacific were the topics discussed at the last regular monthly meeting of the Los Angeles Chapter of Nomads. There were 65 Nomads and guests in attendance, which was preceded by a "get-together" and dinner.

The master of ceremonies for the evening was Earl Cater, who introduced the first speaker, Walter E. Elieson of the United States Department of Foreign and Domestic Commerce. Elieson's subject was "Markets After the War" and in his talk the many factors that will be of vital influence in the conduct of postwar business were touched upon. After the address numerous questions of interest to the oil equipment industry were answered by the speaker.

The next speaker, Al Brick, who was head of Fox Movietone News in Honolulu at the time of the bombing of Pearl Harbor, preceded his talk with motion pictures (in sound) of the bombing. After discussing this attack, Brick told of his experiences with the Navy in the battles of Midway, Bismark Sea, and Coral Sea. At times, in addition to his photographic work, he served as gunner and radio man. Before getting back to this country he spent some time on Guadalcanal.

Among the foreign guests at the meeting were his Excellency, Jorge Zelledon, secretary of the interior of Costa Rica, and Hon. Carlos Grimm, vice consul of Mexico.

National Supply Personnel Changes

R. W. Gordon, manager of the Texas division of The National Supply Company, on October 1 assumed the duties of manager of oil field sales with headquarters at Toledo, Ohio. Gordon has been affiliated with the company since 1917 and formerly served as division sales manager of National's Mid-Continent organization at Tulsa, Oklahoma.

James M. Thompson, Texas tubular manager at Fort Worth, succeeds Gordon as manager of the Texas division. Thompson became affiliated with National in 1940 after a tenure of six years of service with the Norvell Wilder Supply Company as their representative in Texas and Oklahoma.

Water Disposal Symposium

A symposium on oil field waters and oil field brine disposal is being planned to take the form of a joint meeting of the Houston, East Texas, Austin, and College Station sections of the A.I.M.E. to be held at the Stephen F. Austin Hotel in Austin in connection with the annual fall meeting of the Texas Academy of Science, November 12, 1943. The following members of the Institute will take part in the program: Charles Warner, chairman, Petroleum Section, Houston Oil Company; W. S. Morris, East Texas Salt Water Association; L. H. Dial, East Texas Salt Water Association; F. W. Jessen, Humble Oil and Refining Company; F. W. Rolshausen, Humble Oil and Refining Company; F. M. Bullard, University of Texas; Paul Weaver, Gulf Oil Corporation; W. N. White, United States Geological Survey; Fred Barclay, University of Texas; Harry Power, University of Texas; I. W. Alcorn, Pure Oil Company; R. W. Erwin, Salt Water Control, Inc., and J. M. Bugbee, National Lead Company.

In addition to the program of papers and discussion, it is planned to have a noon luncheon with an illustrated lecture by Dr. Fred Bullard on the new active volcano in Mexico and a smoker in the evening with appropriate entertainment.

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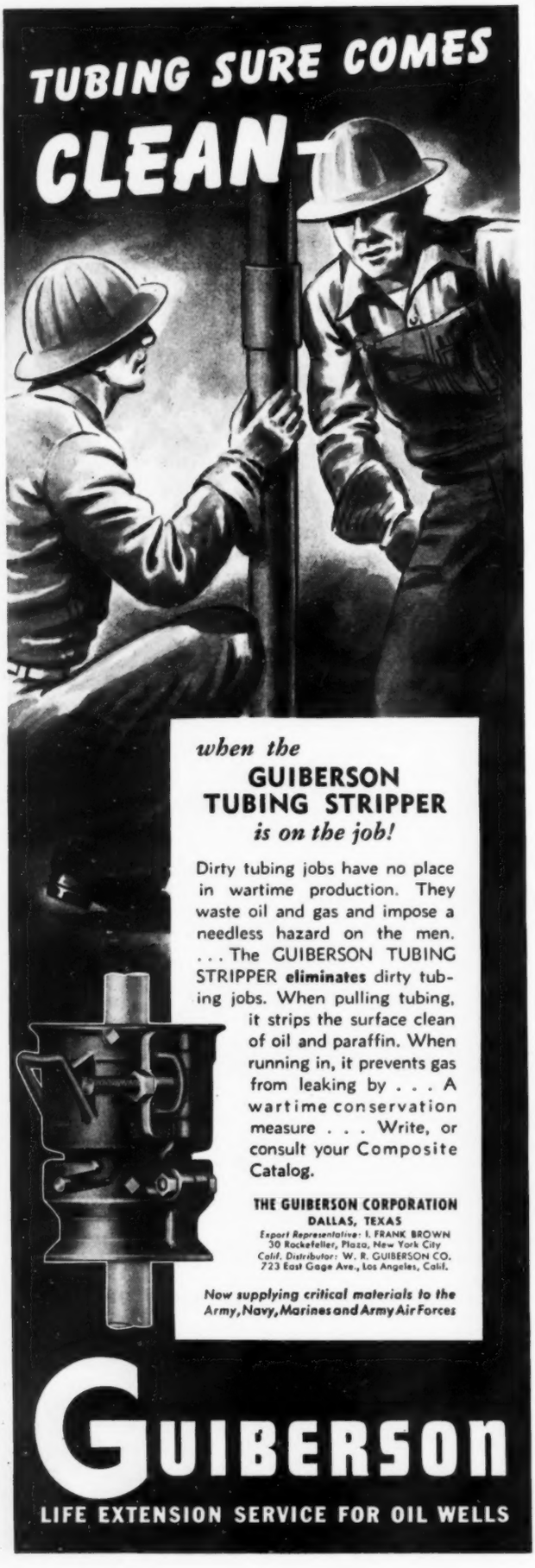
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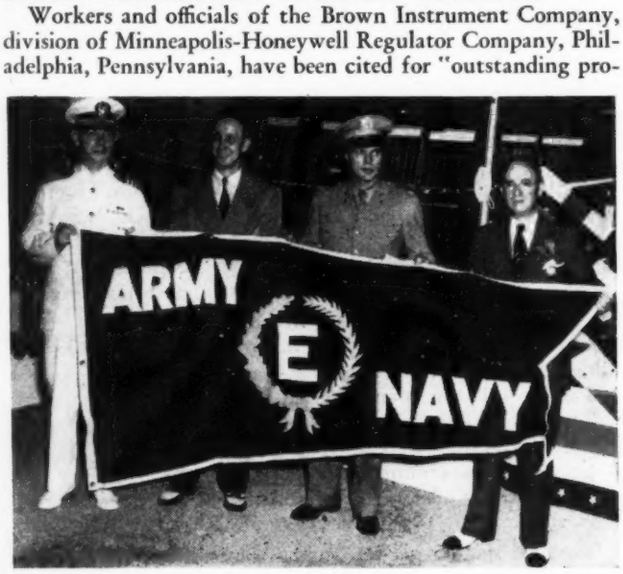
Brown Instrument Workers Honored

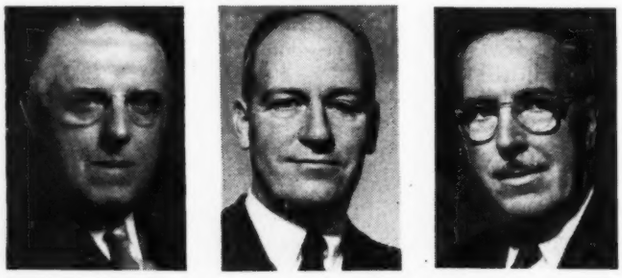
Workers and officials of the Brown Instrument Company, division of Minneapolis-Honeywell Regulator Company, Philadelphia, Pennsylvania, have been cited for "outstanding production of war material," and have received the Army-Navy "E" Award at the direction of Under-Secretary of the Navy James Forrestal. The award represents recognition of the company's record in the making of war equipment and materials, involving the production of instruments for metal-working, chemical and process, oil, food, and textile industries.



Left to right: Capt. Roy W. Bruner, United States Navy; Joseph Abbott, president of Local 116, U. E. R. and M. W. of A.; Lieut. Col. Robert Allen, United States Army, and E. B. Evleth, vice president and general manager of the Brown Instrument Company.

The program was highlighted by a broadcast of the event over Station KYW. After introductory remarks by L. Morton Morley, vice president and general manager of the Brown Instrument Company, Capt. Roy W. Bruner, United States Navy, presented the award, together with the "E" ensign. E. B. Evleth, vice president and general manager, and Joseph Abbott, president of Local 116, U. E. R. and M. W. of A., accepted the award. Richard P. Brown, chairman of the board, made the acceptance address. Presentation of the Army-Navy "E" lapel insignia was made by Lt. Col. Robert G. Allen, U. S. Army, and Harry N. Kuhns, co-chairman of the labor-management committee, accepted the pins.

Standard Oil Promotions



J. R. CARRINGER | H. G. BURKS, JR. | J. W. CONNOLLY *(Conway Studios, Inc.)*

J. R. Carringer has been elected a vice president of Standard Oil Company of New Jersey (Del.), major operating subsidiary of Standard Oil Company (New Jersey). He continues also as general manager of manufacturing operations. At the same time J. W. Connolly, who has been coordinator of marketing divisions, and Harry G. Burks, Jr., assistant to President Chester F. Smith of the operating company, were made directors.

Carringer has spent his entire business career of 40 years with Standard Oil. He came up through the refining business,

having started in the tank car repair shop at Whiting, Indiana, in 1903. He moved to the Bayway, New Jersey, refinery in 1918 as assistant general superintendent, and became manager of the refinery in 1926. He was promoted to assistant general manager of the three New Jersey plants in 1936 and became a director of the "Delaware company," as the operating unit is familiarly known, four years later.

Connolly, who joined the Standard organization in 1933 as fuel oil sales manager, has been 27 years in the oil business, having started with the Mexican Petroleum Corporation in 1916. In addition to his other duties, he has been responsible for sales to the Army and Navy.

Dr. Burks joined Standard as chemical engineer in 1924 after his graduation from the University of Virginia and Massachusetts Institute of Technology. He was made manager of the technical service division of the operating unit in 1936, as well as technical adviser to the vice president in charge of manufacturing. In 1940 he became assistant to the president of the Delaware company.

Le Roi Company Receives "E" Award

Taking its rank among other companies who have been thus honored, Le Roi Company, Milwaukee, Wisconsin, was given the Army-Navy "E" award at a ceremony held at the main plant recently.

The award of the burgee to the men and women of Le Roi Company was made by Brigadier General Raymond A. Fowler, assistant chief of engineers, U. S. Army. The "E" emblems were presented to the employees by Commander H. O. Lord, assistant superintending engineer, Area V, Chicago, Illinois.

Other participants in the program included C. W. Pendock, president of Le Roi Company, who accepted the banner in behalf of the employees; Anthony Bieniewski, co-chairman of the labor-management war production drive committee, who accepted the "E" pins for the employees; Leon F. Foley, master of ceremonies, and Lt. Col. the Reverend Gustav Stearns, chaplain, U. S. Veterans Administration, who pronounced the invocation.

The individual emblems were pinned on the token recipients by Second Lieutenant Leo E. Svitavsky, of the infantry, who was wounded in the battle for Hill 609 in Tunisia. He presented pins to Antoinetta Roosink, the woman employee with the longest record of service; Idele Yandry, who was the first woman to be employed as a shop production worker; Wesley Schaefer, plant engineer, who has been with the company longer than any other male office employee, and Anthony Bieniewski.

After his part in the ceremony, Lt. Leo Svitavsky told of the role that Le Roi compressors have played in the battle of Africa. He told of compressors that he had seen on the almost impossible road projects through the mountainous country of North Africa, which were completed under the most severe conditions ever encountered by men or machines.

SAVES CRITICAL MATERIALS

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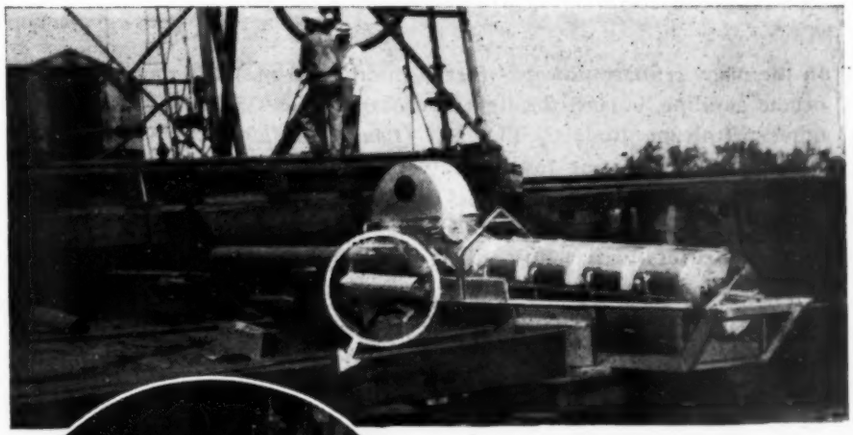

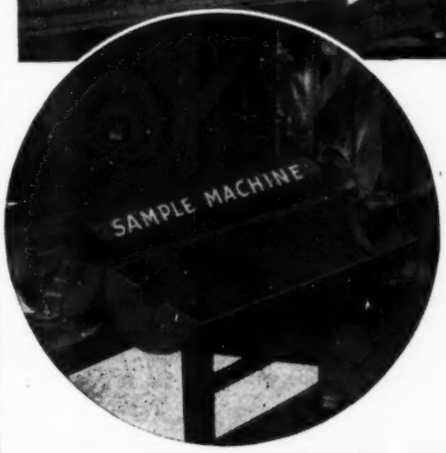

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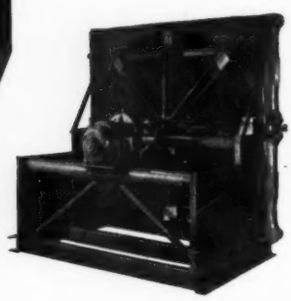

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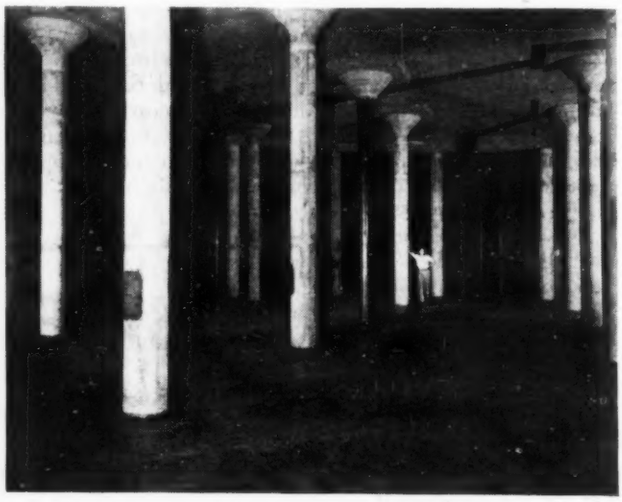
Synthetic Rubber "Wallpaper" Seals Underground Tanks

Designed to help offset a shortage of steel plate, mammoth underground concrete fuel storage tanks, similar to that shown in the accompanying photograph, have recently been installed by the United States Navy in continental U. S. and at strategic overseas bases. Placed underground to afford ade-



Underground concrete storage tank lined with thiokol

quate protection against bombing attacks, construction of the tanks was expedited through the use of thiokol synthetic rubber.

Early in 1940, the Navy's Bureau of Yards and Docks, foreseeing a shortage of steel plate, began to investigate the practicability of using concrete storage tanks to meet the increased demand for fuel storage facilities. Although the heavy fuels presented no problem, light fuels such as Diesel oil and aviation gasoline tended to seep through the pores of the concrete. High octane gasoline, moreover, suffered a serious drop in octane rating and formed a sticky gum when exposed to the alkaline present in the concrete. Intensive research on the part of the Thiokol Corporation, Trenton, New Jersey, resulted in a lining that, when applied to the concrete sidewalls, floors, and columns of the tank, not only protected the octane rating of the gasoline but formed a container that remained leakproof even when the concrete wall cracked due to stresses, ground shifts or temperature changes.

Known as Thiokol FA, the material has long been used in the fabrication of hose and other solvent-resistant specialty products. Applying the thiokol lining resembles the hanging of wallpaper.

A.P.I. Chapter Meets

The regular meeting of the San Joaquin Valley Chapter of the American Petroleum Institute was held at the El Tejon Hotel, Bakersfield, on September 21, with 115 members and guests present. George Suman presided.

Papers presented were:

"Hydraulic Pumping, Its Development and Application," by W. F. "Pete" Slater, Kobe Incorporated.

"The Application of Radioactivity Logging in the San Joaquin Valley," by W. E. "Woody" Woodruff, Lane-Wells Company.

"Cannon on Wings," sound motion picture, was presented by courtesy of Bell Aircraft Corporation, Buffalo, New York.

The next meeting is to be held in Taft on November 16, 1943, at which there is to be an election of officers.

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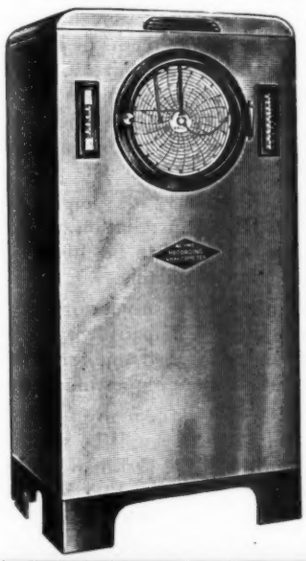

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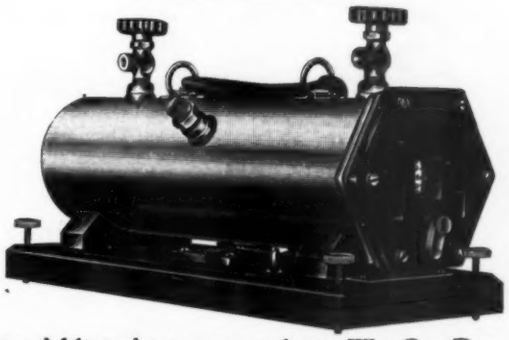

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The Petroleum Engineer Opens New Office

The Petroleum Engineer has established new business and editorial offices at 52 Vanderbilt, New York City. The telephone number is Murray Hill 4-1880. Roger Motheral, New York advertising representative, will make his headquarters there and later an editor for the east coast will join the New York office staff.

The Petroleum Engineer now has offices in three cities: the home office in Dallas, Texas, and outside offices in Chicago and New York. Editorial and advertising staff members are also stationed in Los Angeles, California.

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DESCRIBED AND ILLUSTRATED in Catalog 78 are Lunkenheimer valves, boiler mountings, lubricating devices and kindred products. Copies are sent upon request to The Lunkenheimer Company, Cincinnati 14, Ohio.

"STEAM ATOMIZING OIL BURNERS AND AUXILIARY EQUIPMENT" is the name of 16-page Bulletin 21, released by National Airoil Burner Company, Inc., 1284 East Sedgley Avenue, Philadelphia 34, Pennsylvania. Burners and equipment are well illustrated and described in detail. Copies are available.

FULL INFORMATION on the use of Aldrich "Kosmos" porcelain pump plungers is contained in Data Sheet 57-2. Applicable to Aldrich or any make of reciprocating pump, "Kosmos" plungers have been proved by 25 years service, it is stated. For a copy of the data sheet write The Aldrich Pump Company, Allentown, Pennsylvania.

JUST RELEASED and available upon request is Technical Bulletin No. 6-D on "Properties of Carbon and Alloy Steel Tubing for High Temperature-High Pressure Service." Containing 157 pages of technical data, the volume is published by The Babcock and Wilcox Tube Company, Beaver Falls, Pa.

THE REFINERY SUPPLY COMPANY, 621 East Fourth Street, Tulsa, Oklahoma, will send upon request Catalog 26-A, which includes data on the AC-ME specific gravity gas balance. Designed for efficient use in the laboratory, plant or field, the AC-ME has several special features.

AN INGENIOUS COMPRESSOR CALCULATOR, designed to save critical time in computing compressor requirements or in estimating the performance of present compressor units, has been prepared by The Cooper-Bessemer Corporation, Mount Vernon, Ohio, who is offering it to engineering and operating executives. Pocket size and of slide rule design, the Compressor Selector has proved very useful.

TUBE TURNS, INC., Louisville, Kentucky, has prepared a helpful catalog and data book, No. III, on installation of piping with Tube-Turn fittings, which is said to be 50 to 75 percent faster. Free copies of No. III are available.

LUFKIN OIL GAUGING STEEL TAPES are the subject of Catalog No. 12, prepared by Lufkin Rule Company, Saginaw, Michigan. There are a variety of kinds described, one for every need. Copies of the booklet are sent to those requesting them.

BULLETIN 43-24 illustrates and describes the many features of Vickers hydraulic pumping units. A copy will be sent to those who write for one to Vickers, Inc., 1478 Oakman Boulevard, Detroit, Michigan. The booklet points out that Vickers pumping units save manpower by operating with a minimum of maintenance.

E. R. Smith Completes South American Trip

Elmer R. Smith, export engineering representative of Lane-Wells Company of Los Angeles, California, has completed an extended trip through South American oil fields. His trip covered Peru, Venezuela, Columbia, Trinidad, and Mexico, and was made in the interest of Lane-Wells' South American oil field operations and associated activities.

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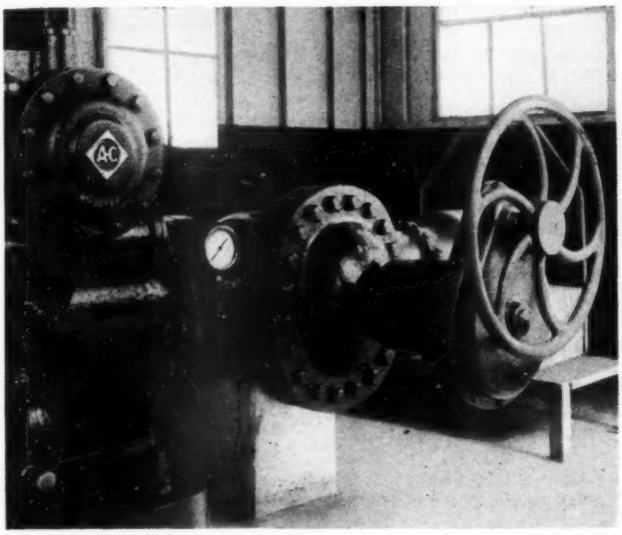

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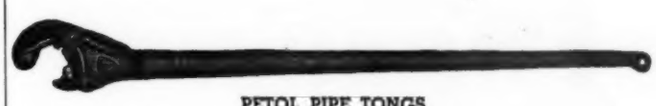

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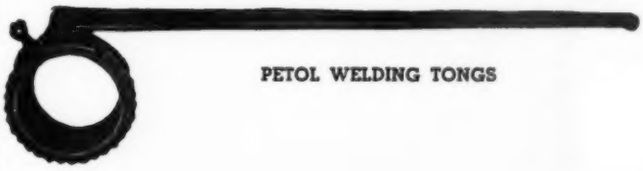

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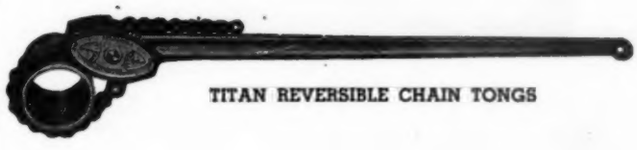

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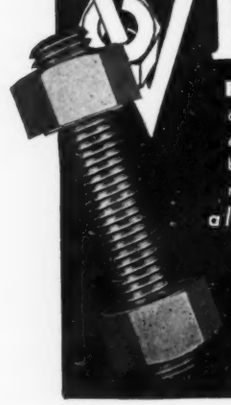

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CUDAHY [MILWAUKEE SUBURB] WISCONSIN

MEETINGS

American Gas Association, Annual Meeting—October 26, 27, and 28, Jefferson Hotel, St. Louis, Missouri.

Independent Petroleum Association of American, Annual Meeting—October 25, 26, and 27, Fort Worth, Texas.

California Natural Gasoline Association, Monthly Meeting—November 4, Barker Bros. Auditorium, 818 West Seventh Street, Los Angeles, California.

Society of Automotive Engineers National Fuels and Lubricants Meeting—November 4 and 5, Mayo Hotel, Tulsa, Oklahoma.

National Stripper Well Association, Annual Meeting—October 25, Blackstone Hotel, Fort Worth, Texas.

Mid-Continent Oil and Gas Association, Louisiana-Arkansas Division—October 29, Slattery Building, Shreveport, Louisiana.

American Petroleum Institute, Annual Meeting—November 8, 9, 10, and 11, Palmer House, Chicago, Illinois.

Exposition of Chemical Industries—December 6, 7, 8, 9, 10, and 11, Madison Square Garden, New York City.

Petroleum Industry Electrical Association and the Petroleum Electric Supply Association—Last week in April, 1944, Dallas, Texas.

"Jack" Howard Passes

John Harold Howard, vice president and general manager of Globe Oil Tools Company, Los Nietos, California, passed away at his home in Whittier, California, September 20.

JOHN H. HOWARD

Howard was born in Tomah, Wisconsin, and became connected with the Globe Oil Tools Company as production manager in 1930; being advanced to his last position of vice president and general manager in 1934. Previous to his connection with Globe he had been identified for a number of years with the General Petroleum Corporation, and the W-K-W Company.

He leaves his widow, Mrs. Heloise Howard; two sons, and one daughter.

Correction

On page 88 of the September issue of The Petroleum Engineer, the picture caption reading "Hortonspheroid tank for storage of butadiene" should have read "Hortonsphere tank for storage of butadiene."

WE WOULD LIKE TO BUY secondhand, subject to inspection, one (1) **300 H.P. Clark Type RA-3, Gas Compressor,** with or without cylinders.

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